APPLICATION FOR UNITED STATES LETTERS PATENT

Title: **System For Tracking and Dispensing Medical Items From Environmentally Controlled Storage Area**

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TECHNICAL FIELD

This invention relates to medical inventory monitoring and dispensing devices and systems.

Particularly this invention relates to apparatus and methods for dispensing and tracking an

inventory of medical items stored in refrigerated or other environmentally controlled storage,

5   which items are used to treat patients in a hospital, clinic or other healthcare setting.

BACKGROUND ART

The treatment of patients in hospitals and clinics usually involves the receipt by the patient of

medical items. These items may include consumable items such as medications. Medical

treatment may also involve other disposable items such as dressings and bandages or other

10 medical equipment. Items implanted into the patient or used in conjunction with surgical

procedures may also be used and consumed during the course of a patient's medical treatment.

Examples of such items include splints, catheters or guide wires which are normally used

during cardiac catheterization or angioplasty. To serve the needs of its patients, a clinic or

hospital must always maintain sufficient stocks of these items on hand. Further, as medical

15 items are often expensive, the charges associated with their use must be accurately billed to the

patient.

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Currently most systems for tracking inventory and use of medical equipment items in a

hospital or clinic environment are largely manual systems. The persons responsible for

maintaining an inventory of particular items must monitor the use of the items in each storage

location within the hospital and order additional supplies when it is noted that the available

5   stocks are running low. Often personnel are only familiar with the stocks available in a

particular storage location and as a result, additional stocks may be ordered even though ample

supplies are available elsewhere in the same facility.

Certain drugs used in the course of medical treatment are regulated narcotics. Supplies of

such drugs must be kept in secure cabinets. Items may be dispensed from the secure cabinets

10   only by two (2) authorized users accessing the material and certifying the manner in which it is

used. The use of such narcotics also may require considerable paperwork which takes away

valuable time that could be used for treating patients.

Some types of medical items must be maintained in refrigerated or other environmentally

controlled storage. Often such storage must be maintained until almost the time of use.

15   Keeping track of items that require refrigerated storage and assuring that adequate inventories

of such items are always available presents additional challenges compared to medical items

which do not require such special conditions. Due to the diverse types of medical items that

may require storage in refrigerated conditions it is also difficult to selectively restrict access to

such items.

The recording of medical items so that the patient may be billed for their use in the course of treatment is also largely a manual operation. The fact of use by the patient must be recorded in the patient's chart. In some cases items have peel-off labels that include a bar code that can be scanned and used for billing purposes. However, this still requires that the nurse or

5   medical technician transfer the correct coding to the proper location for later billing.

Complications in billing become even greater when items are removed from inventory to accomplish a planned surgical procedure and then the items are not used. A patient may be charged for use of a particular item which is removed from inventory in anticipation of surgery. If during the surgery the item is not needed, a corresponding credit must be issued

10   when the item is returned to stock. All of these activities take time away from persons who could otherwise devote their time to the treatment of patients. Such tracking and billing practices are also prone to inaccuracies which may cause the hospital or clinic to lose money or which may result in overbilling of the patient.

Thus there exists a need for an apparatus and system for monitoring and dispensing medical

15   items in hospital or clinic environments that can more accurately monitor inventories, dispense medical items and correlate the use of medical items with the patient whose treatment has included their use.

DISCLOSURE OF INVENTION

It is an object of the present invention to provide a system for monitoring an inventory of medical use items to provide an indication of what items have been used.

It is a further object of the present invention to provide a system for monitoring the use of medical use items so that supplies may be replenished before depletion.

It is a further object of the present invention to provide a system for monitoring an inventory of medical use items that monitors a plurality of items in real time.

It is a further object of the present invention to provide a system for monitoring an inventory of medical use items that minimizes the processing of paper forms.

It is a further object of the present invention to provide a system for monitoring and dispensing medical use items that indicates the patient whose treatment has involved the medical use items.

It is a further object of the present invention to provide a system for monitoring and dispensing medical use items that can be used to indicate the technician or physician who has used such medical use items.

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It is a further object of the present invention to provide a system for monitoring and dispensing medical use items that provides for crediting of a patient's account upon return of an unused item to inventory.

It is a further object of the present invention to provide a system for monitoring and dispensing

5   medical use items that is used to store and dispense restricted items in a secure manner.

It is a further object of the present invention to provide a system for monitoring and dispensing medical use items that are stored in a refrigerator or other compartment having controlled environmental conditions.

It is a further object of the present invention to provide a system for monitoring and dispensing

10   medical use items that can guide a user to select the items that will be used in a particular medical procedure.

It is a further object of the present invention to provide a system for monitoring and dispensing medical use items that may be used to track and dispense a wide variety of various items and to record their use in a clinical or hospital environment.

15   It is a further object of the present invention to provide a system for monitoring and dispensing medical use items that enables a user in the course of a dispensing sequence to selectively review and dispense medications by either the generic name or the brand name.

It is a further object of the present invention to provide a system for monitoring and dispensing medications that enables a user to dispense together predetermined medical items that are used as a kit in the conduct of a medical procedure.

It is a further object of the present invention to provide a dispensing mechanism that reliably

5   dispenses medicines to a user in response to the user's selection of items.

It is a further object of the present invention to provide a method for monitoring and dispensing medical use items.

It is a further object of the present invention to provide a method for monitoring an inventory of medical use items that are not tracked to a patient.

10   It is a further object of the present invention to provide a method for dispensing medical use items that can be carried out more rapidly and efficiently.

It is a further object of the present invention to provide a method for more efficiently restocking storage locations with medical use items.

It is a further object of the present invention to provide a method for monitoring and

15   dispensing medical use items stored in a refrigerator or other environmentally controlled storage area.

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It is a further object of the present invention to provide a system for monitoring and dispensing medical use items that enables monitoring and dispensing of medications when portions of the system are not operational.

It is a further object of the present invention to provide a method for operating a system for monitoring and dispensing medical use items that selectively updates stored information to maximize accuracy.

Further objects of the present invention will be made apparent in the following Best Modes for Carrying Out Invention and the appended claims.

The foregoing objects are accomplished in a preferred embodiment of the invention by a system for monitoring and dispensing medical items in a clinical or hospital environment. This system includes a plurality of item storage locations. A particular type of medical item may be stored in each location. For example, one type of medical item may include a particular type of catheter. Another may be a particular type of medication packaged in a particular dosage. Each location in the system includes at least one unit of the particular type of medical item.

A sensor is positioned adjacent to certain storage locations. The sensor is particularly adapted to sense the addition or subtraction of a unit of the particular type of medical item that is

stored in the location. As a result, each time a unit of the particular item is added or removed

from storage in the location, the sensor senses this and generates a signal.

A counter is connected to each such sensor and records the number of units added or removed

from each location. The counter holds a count of the change in the number of units at the

5   location since the last time the counter was read.

The counters associated with each location are connected to at least one processor and at least

one memory or data store. The data store includes a total of the number of items that are

located in storage at the location. Periodically, the processor polls each of the counters and

reads the change in the number of units stored therein. Thereafter the processor is operative

10   to update the total number stored in the memory to reflect the number of items currently stored

at the location.

Embodiments of the invention include a data terminal which includes a user interface and

which terminal is connected to the processing system and the counters. The data store

includes records concerning patients, procedures, authorized users of the system and each of

15   the products stored in each of the locations, including pricing information. The data store

further preferably includes data representative of medical items prescribed for patients as well

as the medical items that have been taken by users of the system for patients. The data store

further preferably includes data representative of the function the user usually performs and

the activities the user has performed. The data store further preferably includes data

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representative of whether each particular medical type item is tracked to patients, whether each type of medical item is billed to patients, and the quantity or level of medical items stored in each storage location.

5   The data store preferably includes data in correlated relation concerning the brand names and generic names for medications and other medical items stored in the locations of the system. The data store further preferably includes information on "kits" which are groups of medical items that are used together. Such kits may be groups of items which are used together repeatedly, such as in doing a diagnostic test. Alternatively, a kit may comprise items that are to be used on a one-time basis, such as for a particular patient's operative procedure. The data

10   on items in each kit are stored in correlated relation with the kit designation in the database.

A system user, such as a technician or nurse, may use the interface of the data terminal to identify the particular patient who is to receive the medical items taken by the user. Upon removal or dispense of the items from the storage locations, the use of such items is recorded in correlated relation with the patient record in the data store so that the patient's chart may be

15   automatically updated and the item charged. In addition, a user using the data terminal may review information in the data store concerning procedures and physicians to determine what medical items are required by a physician to conduct a procedure and may remove such items for delivery to an operating room. This information may include kits which relate to particular procedures. The user is enabled to take or cause medical items to be dispensed

20   through inputs to the data terminal.

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The user may also use the interface of the data terminal to check stocks of medications which are available as well as medications which have been prescribed for a patient. The user is enabled to use the interface to check the brand name for medical items designated by generic name, and vice versa. This is done by the user interface interfacing with the drug information

5   stored in the data store. This enables a user to check for the availability of medications by either brand or generic name. This also enables a user to check the appropriate character of an item prescribed by checking its other name. This also enables a user to determine the availability and use a brand name or generic name equivalent to the medical item prescribed, when the brand or generic type prescribed is not available.

10 In embodiments of the invention, controlled substances such as narcotics, may be dispensed using the system from a dispenser mechanism or an electronic lock drawer. In some embodiments, the user is required to identify himself at the display terminal. This information is processed and compared to authorized user records in the data store to verify that the user is an authorized user. In some embodiments the identifying information on the

15 user may be placed on an encoded object or article such as a card, and the user may be assigned a personal identification number (PIN) that is memorized by the user. The data terminal preferably includes a reader for reading the coded object and for receiving the user's PIN number which has a predetermined relationship to the data on the encoded object. The proper input of the PIN with the corresponding user's coded object verifies that a proper user

20 is requesting to gain access to the items. For some strictly controlled substances two (2) authorized users may be required to input their coded objects and PIN numbers in order to

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gain access to the controlled items. In alternative embodiments biometric type identification devices may be used, such as those that identify a user by fingerprints, hand scans, retina scans, iris scans, voice prints or other body features.

5   In embodiments of the invention medical items may be stored under environmentally controlled conditions. One such storage location is in an interior area of a refrigerator. The refrigerator may be of a conventional or unconventional type having a door for accessing the interior area. The refrigerator may preferably be fitted with a lock module which enables selectively enabling access to the interior area in response to signals from the display terminal. A lock module enables the refrigerator to operate in a manner similar to an electronic lock

10   drawer. Varying levels of security for refrigerated items may be provided by using several refrigerators each of which includes its own lock module. Alternatively subcompartments within the refrigerator, each with individual lock modules may be provided. In the preferred embodiment the lock modules are readily attached to exterior surfaces of the refrigerator.

As with the previously described embodiments, once the authorized user has provided the

15   necessary identification, the processor operates to cause the desired substance to be dispensed or made accessible to the user. The user is also required to input the corresponding patient data so that the patient's chart and billing may be updated.

In an alternative embodiment a user is enabled to access the system using a scanner or similar reading device. Instead of inputting data into the display terminal to identify himself, the user

scans a machine readable code on a badge, identification card or other article or body feature corresponding to the user. For the dispensing of narcotics, which requires two authorized users, two users may scan their respective identification item using the reading device. The reading device preferably includes an output device, such as a small screen, which provides messages to prompt users on the steps to be taken in a manner similar to that done when the user operates a display terminal. The reading device also preferably has an input device thereon, such as an alphanumeric keypad and/or function keys, which provides additional ways for a user to provide inputs to the reading device in addition to scanning machine readable indicia.

In the alternative embodiment, storage locations such as shelves, drawers and/or refrigerator units preferably have machine readable indicia adjacent thereto. The machine readable indicia corresponds to the location designator for the storage location, and the data stored in the data store includes data representative of the type of medical item stored in each location. The storage locations also preferably include a further machine readable indicia thereon which is indicative that the quantity of medical items in the storage location is depleted. The further indicia is preferably positioned in or adjacent to the storage location so as to be accessible by the reading device when the last of the medical items in the storage location has been removed.

The alternative embodiment including the reading device is useful for indicating various types of quantity conditions which occur at storage locations. The preferred form of the reading device includes a processor and a local data store therein which enables it to perform

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operations in accordance with its programming, which is referred to herein as its configuration. The reading device also produces transaction messages which are sent to other components of the system.

Certain types of medical items are not tracked or billed to patients. Such items may include aspirin, cotton swabs or bandages. Items of this type may be stored in an open storage location such as open shelving and are available for any user to take. The storage locations for items that are not tracked to patients are preferably marked with machine readable indicia of a type that is visibly distinguishable to a user from indicia for storage locations holding items that must be tracked and billed to patients. The storage locations for items that are not tracked to patients are preferably marked to show a desired level or quantity (a "par value") of medical items that should be kept in the storage location. If the level of medical items in the location drops and a user observes that it is below par value, the user may scan the indicia with the reading device. The reading device is preferably configured to treat the scanning of indicia corresponding to a storage location, absent previously inputting data related to a user or a patient, as indicative of a quantity condition at the location which corresponds to the storage location being below par value.

Alternatively, when all the medical items have been removed from the storage location the user may operate the reading device to read the further indicia adjacent the storage location representative of the condition that all the medical items in the location have been depleted. Such a condition is an alternative quantity condition which causes different signals to be

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generated by the system from those corresponding the first quantity condition. Transaction

messages comprised of signals are produced by the reading device corresponding to the

different quantity conditions. These transaction messages are sent to other components of the

system, and in the case of messages which indicate that a storage location is below par value

5   or depleted, are responded to by restocking the storage location with an additional quantity of

medical items.

In the alternative embodiment the reading device can be used for tracking medical items taken

for use by patients. A user may log into the system using the display terminal or by using the

reading device to read their identification card, badge, other identifying article or feature.

10   Most users of the system who are nurses or medical technicians perform activities which are

primarily the dispense of medications for use by patients. The data store preferably includes

data representative of the dispense function as the function associated with such users. The

user will be considered by the system as performing this function unless the user provides an

input to the reading device that indicates that he or she is going to perform a different

15   function.

In one form of the system, once the user has logged onto the system he or she may select a

patient at the display terminal and may scan or read the indicia at the locations from which

medications are taken for the patient. This will cause the information concerning the taking of

the medications for the patient to be stored in the data store. If access to the desired

20   medication or medical item is controlled by an access control device, such as an electrical lock

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on a cabinet, a lock module on a refrigerator, or an electronic lock drawer, the reader can be used to gain access to the medical items controlled by the access control device. The storage location or locations to which access is controlled by the access control device preferably includes machine readable indicia on its exterior. In operation of the described form of the

5   system, when an authorized user is logged on the system, scanning the indicia associated with the access control device enables the user to access the medical items, such as by unlocking a lock or opening a drawer. The indicia corresponding to the locations from which the medical items are taken may then be read with the reading device. A transaction message is generated which is used to update the information in the data store. The transaction message preferably

10   updates the data concerning medications taken for the patient, as well as the inventory status for medical items at the various storage locations from which the items have been removed. The user can then select another patient at the display terminal and repeat the process.

The system of the alternative embodiment of the invention also preferably has available in the data store not only data representative of the patients who may receive medical items but also

15   the medical items that have been prescribed for use by such patients. This enables printing reports with a report generating device. Such reports may include both human readable as well as machine readable indicia representative of patients and their prescribed medications. In an alternative form of the invention a user may use the reading device to select a patient by reading the indicia corresponding to that patient from a report rather than selecting the patient

20   using the display terminal. The user may then scan the indicia from the storage locations to indicate the medical items taken for the patient in the manner previously described.

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Alternatively, the indicia corresponding to a medical item may be scanned from the report if access to such medical item is controlled by an access control device. For example, if the item is stored in the interior of an electronic lock drawer, refrigerator or a dispenser, scanning the indicia on the report causes the system to operate to make the item accessible to the user by

5   opening the access control device to the storage location or by causing the item to be dispensed from the dispenser.

A user may select several patients and their associated medical items in a sequence using the indicia on a report. The reading device preferably holds the information until the user indicates that they are done by "logging off" the system. This avoids slowing the system

10   operation by trying to send messages to other components of the system while the user is operating the reading device. After the user has logged off, the transaction messages may be sent as a batch to the other components of the system. A user may log off the system by inputting a command through the input device such as the keypad on the reading device. Alternatively, a user may log off by scanning machine readable indicia which indicates that the

15   user is logging off the system, or by a new user scanning indicia associated with the new user. Alternatively, or in addition, the reading device may be provided with a storage location referred to herein as a cradle, and a log off signal may be generated whenever the reading device is returned to its cradle. Of course in alternative forms of the system the reading device may send its transaction messages as events are occurring rather than waiting until after

20   a user logs off.

The reading device may in various embodiments be connected to the remainder of the system by a data line or may communicate its messages through forms of wireless communication. Dispensers, drawers and other types of storage locations which incorporate access control devices in the described embodiment are connected to the system by data lines. However in

5   alternative forms of the system such devices may be connected to the remainder of the system through wireless communication methods. Such dispensing devices may in further alternative embodiments include a processor and a memory which enables them to operate in an off line mode of operation. Such devices may then communicate with the rest of the system to periodically deliver information on dispensing or restocking activities. This communication

10   may be accomplished by data line, wireless communication methods or through an intermediate device which can receive data from the dispensers, store the received data, and deliver it to the rest of the system. The intermediate device may have various portable or stationary forms, and in certain embodiments may be the reading device or a device functionally similar thereto.

15   The alternative embodiments which include the reading device may also be used to facilitate restocking of the system. Labels may be provided on storage locations to indicate a restocked condition. Alternatively, or in addition, reports can be generated based on the data in the data store which shows the storage locations which require restocking with additional items. Such reports may include human as well as machine readable indicia showing the item to be

20   restocked, the storage location, the number of units to be added, as well as an indication that a restock function is to be performed. Users who primarily perform restocking functions may

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be provided identification cards, badges or other associated articles or features with machine readable indicia that identifies them, and the data store includes data which indicates that the activity normally carried out by such users will be a restock function unless otherwise specifically indicated.

5   Users who restock storage locations may identify themselves to the system using the display terminal, or alternatively by reading the indicia from their identification card, badge, article or feature with the reading device. Such users may indicate that storage locations have been restocked by scanning the machine readable indicia for a location from a report or from the storage locations, or both, in accordance with the configuration of the reading device.

10   Numerical data concerning the number of items in inventory can be counted and input through the keypad on the reading device. The reading device is also preferably configured to provide prompt messages on a screen or other output device, to guide a user through the restocking process.

In embodiments of the invention the dispensing and restocking processes may also be

15   accomplished through the interface of the display terminal, as well as by using the reading device. This enables users of the system to accomplish their functions using either the display terminal or the reading device, and in the event one malfunctions, required activities can still be carried out. This ability to carry out functions through the reading device, the display terminal, or both working cooperatively increases flexibility and reliability of system

20   operation.

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In embodiments of the invention, the system may interface with other computer systems such as the admission-discharge-transfer (ADT) computer system that the hospital uses to track patients. This is a computer system which is used in a hospital or clinic to track patient location and activity. In addition, the system of the present invention may also be connected

5   to the hospital information system (HIS) which is the record storage facility of the hospital which maintains computerized records concerning patients. The system may be interfaced to the pharmacy system which keeps records of medications prescribed for each patient. As a result, patient activity, record keeping, and billing may be automated through the system of the present invention, along with inventory monitoring. The system of the present invention may

10   also be used to produce a wide variety of reports from the data store related to patients, authorized users, physicians and various types of items used in inventory. Such a system may also be integrated with an automatic ordering system so as to transfer supplies from one location to another where they are needed and/or to automatically place orders for additional supplies with vendors when supply levels reach a limit.

15   BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is a side cross sectional view of an inventory monitoring apparatus called a hook register used in the system of the present invention.

Figure 2 is a front cross sectional view of the hook register shown in Figure 1.

Figure 3 is similar to Figure 1 depicting a medical item being removed from the hook register.

Figure 4 is a partial cut-away top plan view of a further inventory monitoring apparatus of the present invention called a box register.

Figure 5 is a side elevation view of the box register shown in Figure 4 as seen along line v-v

5   of Figure 4.

Figure 6 is an enlarged view of the circled portion VI shown in Figure 5.

Figure 7 is a side view of a lever used in the box register shown in Figures 4 and 5.

Figure 8 is a top plan view of the lever shown in Figure 7.

Figure 9 is a front view of an alternative box register.

10   Figure 10 is a partial side view of the box register along line 10-10 in Figure 9.

Figure 11 is an enlarged side view of a switch and lever of the box register shown in Figure 9.

Figure 12 is a front, partial cut-away view of the lever and switch of the box register shown in Figure 9.

Figure 13 is a schematic view of the system for monitoring and dispensing medical items including the hook registers and box registers.

Figure 14 is a top plan view of a dispenser mechanism for vials containing medications.

Figure 15 is a cut-away side view of the dispenser shown in Figure 14 with the gate members

5   thereof in a first position.

Figure 16 is a view similar to Figure 15 with the gate members of the dispenser in a second position.

Figure 17 is a side view similar to Figure 16 with the gate members in a third position wherein a vial is dispensed from the mechanism.

10   Figure 18 is a cross sectional view corresponding to the dispenser as shown in Figure 15.

Figure 19 is a side view of the dispenser mechanism corresponding to Figure 16.

Figure 20 is a side view of the dispenser mechanism corresponding to Figure 17.

Figure 21 is a side view of the dispenser mechanism and gate members in the positions shown in Figure 15.

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Figure 22 is a side view corresponding to Figure 21 including hidden edge lines.

Figure 23 is a side view of the dispenser mechanism with the gate members in the positions shown in Figure 16.

Figure 24 is a side view of the dispenser mechanism corresponding to Figure 23 including

5   hidden edge lines.

Figure 25 is a side view of the dispenser mechanism with the gate members in the positions shown in Figure 17.

Figure 26 is a side view of the dispenser mechanism corresponding to Figure 25 including hidden edge lines.

10   Figure 27 is a sectional side view of the dispenser mechanism shown in Figure 14 located inside a medicine dispenser.

Figures 28 through 39 are windows displayed on the touch screen of the data terminal in an embodiment of the invention, with Figure 28 being a patient browser window.

Figure 29 is a patient information window.

Figure 30 is a patient usage browser window.

Figure 31 is a med order browser window.

Figure 32 is a supply browser window.

Figure 33 is a kit browser window.

5   Figure 34 is a kit information window.

Figure 35 is a supply browser window selected to display trade name information for the

displayed medical items.

Figure 36 is a supply browser window like Figure 35 selected to display generic name

information for the displayed medical items.

10   Figure 37 is a physician/route/site browser window selected to display route information for a

medication.

Figure 38 is a window through which a user may log into a display terminal.

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Figure 39 is a non-itemized supply inventory window which is used to review and input information concerning non-itemized medical items which are not tracked to patients.

Figure 40 is a schematic view of an alternative embodiment of the system for monitoring and dispensing medical items.

5   Figure 41 is a label with machine readable indicia for identifying a storage location.

Figure 42 is a label with machine readable indicia for indicating an out of stock condition at a storage location.

Figure 43 is a label with machine readable indicia for indicating that a storage location has been restocked.

10   Figure 44 is a label with machine readable indicia to indicate that the quantity of items in a storage location is below a desired level.

Figure 45 is a schematic view representative of placement of labels similar to those shown in Figures 41 and 42 adjacent a storage location for a medical item.

Figure 46 is a view of machine readable indicia which may be included in a restock report.

Figures 47-49 are a logic flow diagram showing steps that are carried out in the reading device of the alternative embodiment of the system shown in Figure 40.

Figure 50 is an isometric view of a refrigerator which holds medical items in an interior area, the refrigerator having a lock module mounted thereon.

Figure 51 is a front view of the lock module and bolt supporting bracket shown in Figure 50.

Figure 52 is a partially sectioned view of the lock module.

Figure 53 is a partially sectioned top view of the bolt supporting bracket.

Figure 54 is a sectional side view of the lock module and bolt supporting bracket with the bolt shown in engaged relation with the lock module.

Figure 55 is a schematic view of the connections between a data terminal and a plurality of lock modules and other devices.

BEST MODES FOR CARRYING OUT INVENTION

Referring now to the drawings and particularly to Figures 1 and 2, there is shown therein a first embodiment of an inventory monitoring apparatus for use in the present invention referred

to as a hook register and generally designated by reference numeral 10. Apparatus 10 includes

an elongated housing 12 including an upper wall 14, a lower wall 16, side walls 18 and 20, a

front wall 22 and a rear wall 24. Housing 12 may be formed of any suitable durable material

such as plastic or metal. A clip assembly 26 or similar attachment mechanism is desirably

5   carried by a flange 28 of rear wall 24 whereby the housing may be detachably fastened to a

rail or similar support structure 30 affixed to a wall 32 or like surface. As will be discussed in

greater detail hereafter, rail 30 may also carry a communications bus 34 or other suitable

means for electrically connecting the apparatus 10 to a similar apparatus and to a remote

computer and data terminal.

10   An object support means is designated by reference numeral 36. As illustrated, the object

support may assume the form of an elongated rigid or angled rod which may be suitably

formed of metal or plastic. A shorter leg 38 of the object support means is affixed such as by

threaded fasteners 40 to the rear wall 24 of housing 12. A longer leg 42 of the object support

means extends generally longitudinally of the housing 12 and is capable of supporting a

15   plurality of objects 44. Thus, according to the first embodiment, object support means 36

resembles an elongated peg or rod which suspends objects 44 from holes or perforations 46

provided therein (see Figure 2). The longer leg 42 of support means 36 also desirably is

formed with a raised portion 42A to prevent the objects from unintentionally sliding off the

object support means.

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It will be appreciated that hook register 10 finds beneficial usage with articles or objects which are suitable for suspension and whose inventory it is desirable to monitor. Typical items may include packages containing medical items such as drugs, medical equipment, supplies, including for example, catheters and guide wires for angioplasty or other medical items which

5   should be strictly and accurately monitored because of theft, safety, critical need or other concerns. For this reason, the object support means may assume any form necessary or desirable to support the objects supported thereby. That is, the object support means may be configured as a rack, multiple hooks or pegs or similar cantilevered members, a tee bar or other such equivalent constructions.

10   A switch actuating means 48 desirably configured as a pivotable lever is mounted generally at its midpoint to housing 12 by a pivot pin 50. In the preferred embodiment, a first end of lever 48 projects through an opening 52 in lower housing wall 16. It is also contemplated that lever 48 may be adapted to project through an opening similar to opening 52 and may be provided in any other wall of housing 12 so long as those components necessary for the proper

15   functioning of the apparatus 10 are correspondingly repositioned to accommodate the desired orientation and operation of lever.

A second end of lever 48 is connected to suitable biasing means 54 which in the preferred embodiment is a spring. In the preferred embodiment, the biasing means is a tension spring, however in other embodiments biasing means such as torsion springs, compression springs,

20   elastomeric means or the like may be used. The biasing means normally biases the lever to an

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"inoperative" position in which the lever extends generally traverse to the longer leg 42 of the object support means 36 of the hook register as depicted in Figure 1.

It is important that the first end of lever 48 sufficiently project from housing 12 whereby it may be contacted and displaced by a medical item 44 which may be either added to or

5   removed from the object support means. To assure that the lever will interfere with the passage of an object, either into or out of a location on the object support means, a first end of lever 48 is provided with a notch 56. Notch 56 is configured to receive the longer leg 42 of the object support means 36 therein. As a result, when a medical item is removed from its storage location on the object support means, the object contacts and then displaces the lever

10   so as to rotate it outward. The object then passes the lever and once this occurs the biasing means 54 returns the lever to the inoperative position.

A printed circuit board 58 is mounted in the interior of housing 12. Apart from certain circuitry components specifically identified below which are essential to provide an adequate appreciation of the operation of the hook register, it will be understood that circuit board 58

15   includes printed circuitry and other circuitry components.

Electrical switch means are supported by and electrically connected to the circuit board 58. During operation the switch means serve as part of a sensor that generates signals indicative of the placement of objects into the storage location on object support means 36 or removal of such objects from the storage location. The preferred embodiment of the hook register utilizes

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a pair of switch elements 60 and 62 as the electrical switch means. In the preferred

embodiment, the switch elements are Hall-effect sensors which change states (off-to-on) when

a magnetic field is detected within close proximity. Lever 48 carries a compact permanent

magnet 64 which serves as an actuator means. The magnetic field produced by magnet 64 is

5   capable of being sensed by switches 60 and 62 to affect changes in their status. The signals

indicating changes in the status of the switches are detected by a signal processing circuit 65

which converts the signals to an appropriate form to be received and counted by a

microprocessor 66. The microprocessor 66 in the hook register serves as a counter which

stores a count therein as later described.

10   Operation of the hook register 10 is graphically represented in Figure 3. Specifically, the

object 44, which is preferably a medical item, is shown at the instant in time when it has fully

deflected the lever 48 against the force of the biasing means 54 and has just passed the first

end of the lever. At this moment, the permanent magnet 64 is pivoted into a substantially

facing relationship with magnetic field detector switch 60. Switch 60 is triggered upon

15   detection of the magnetic field in proximity to the switch element and generates a signal

indicating that one object unit has been removed from the object support means 36. Once the

medical item has passed off the object support means, the biasing means returns the lever to

the inoperative position.

Similarly when a medical item is placed on to the object support means 36, the lever 48 is

20   pivoted in an opposite direction. This causes the permanent magnet to trigger the magnetic

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field detection switch element 62. This generates a signal indicating that one object unit has been added to the storage location on the object support means. Although in the preferred embodiment magnetic field detection switches are used, other suitable switches such as three-way toggle switches, photo sensors, optical encoders, capacitive or inductance sensors and the like may be employed as sensors to achieve and generate the additive and subtractive article registration signals. Likewise, the switch actuating means may assume forms other than a pivotable lever depending on the type of medical item and storage location involved. For example, a linearly reciprocal lever, a flexible flap or noncontact type sensors may be used in other embodiments.

The microprocessor 66 receives through signal processing circuit 65 the signals generated by switches 60 and 62. The microprocessor contains software programs which record and count the state of the switches each time a change is detected. The number and direction of the changes are counted and stored as a count in the microprocessor. In addition, the microprocessor includes a computer program that enables it to be reset upon receipt of signals from a remote location. In the preferred embodiment, the microprocessor also has stored in association therewith a location identifying indicator that is representative of a number and/or other data uniquely associated with the particular hook register. Each hook register and other dispensing apparatus in the system of the preferred embodiment has a location identifying indicator associated therewith.

The electronic circuitry of the inventory monitoring apparatus also has the ability to communicate its count information to other components of the system of the present invention. In each hook register, the processor 66 is connected through a ribbon cable 68 which is connected with an electrical coupling 70. Coupling 70 electronically couples with a

5   communication bus 34. In this manner, circuit board 58 is enabled to receive power from a remote power source and is enabled to transmit and receive data through communication bus 34.

The operation of the hook registers 10 in the inventory monitoring and dispensing system of the present invention is best shown with respect to Figure 9. Each of the hook registers is

10   connected to the data bus 34. Each of the hook registers is connected to the data bus 34, which is connected to a hook controller shown schematically as 72. Hook controller 72 includes a processor and a data store therein which are operable to communicate with each of the hook registers 10. The hook controller 72 is operable to periodically poll each of the hook registers 10 on the data bus. The hook controller reads and receives the count information in

15   each of the hook registers and stores it in conjunction with the location identifying information associated with the particular hook register from which the count was received. After the reading of the count information in the register and transmission of the data to the hook controller 72, the count information in the microprocessor 66 may be erased so a new count can be started. Alternatively, the microprocessor 66 in the hook register may be programmed

20   to store the count information and the time each such count was generated for a period of time while generating new count information. This can be done to assure that usage of items from

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any hook register can be recovered even in the event of the failure of a hook controller. While

Figure 9 shows only four (4) hook registers connected to controller 72, it will be understood

by those skilled in the art that many more hook registers may be so connected on the data bus.

As a result of polling each of the hook registers 10, the hook controller 72 has in its associated

processor and data store the count of units taken or added in conjunction with the identifying

information associated with each hook register. The hook controller 72 is connected by a

further data bus 74 to a data terminal 76 sometimes referred to hereafter as a display terminal.

Of course other hook controllers and controllers connected to other types of registers may also

be connected to data bus 74. The data bus 74 is used to transmit and receive information from

the connected controllers to the data terminal 76.

Data terminal 76 includes a display screen 78 which serves as a data output device. In the

preferred embodiment, screen 78 is a "touch screen" of the type known in the prior art

wherein a user may input data by placing a finger adjacent to icons displayed on the screen.

Sensors overlying the screen sense the position of the finger and convert it to input data. As a

result, touch screen 78 serves as a graphical user interface which includes a data input device

as well as a data output device. In other embodiments other types of input devices and output

devices may be used. Data terminal 76 in the preferred embodiment further includes a card

reader 80. Card reader 80 may be used to read data encoded on a magnetic stripe of a user's

identification card. Of course in other embodiments of the invention other equivalent reader

means for reading coded objects or for reading a user's features such as fingerprints or retina pattern may be used depending on the level of security desired.

In the operation of this embodiment of the invention, a medical technician who wishes to operate the system and remove medical items from the hook registers 10 operates the display

5   terminal. The terminal screen outputs a visual prompt for the user to identify himself or herself to the system by input of identifying data. In certain embodiments, the identification may be accomplished by the user inputting an identification number assigned to the user by touching the appropriate numbers on a graphical keypad presented on the screen of the display terminal such as shown in the user log-in screen in Figure 38. In other embodiments, the user

10   may be requested to swipe their card in the card reader so that the magnetic stripe thereon may identify the user to the terminal. In embodiments where high security is required, a user may be requested to input both their card and a personnel identification number (PIN) into the display terminal. The PIN has a predetermined relationship to the data on the card, and the data terminal may be operated further only if a proper card and PIN are input.

15   When a user enters their identifying information at the display terminal, the display terminal communicates through a local area network (LAN) 82 to a remote computer 84 which includes a processor and a data store therein schematically indicated 85. Computer 84 may have greater and faster processing capabilities and more memory than a display terminal. The computer 84 has stored therein or in another computer operatively connected therewith,

20   information records associated with authorized users. If the data input by the user at the

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display terminal corresponds to a record for an authorized user, then the display terminal will enable the user to operate the system. In alternative embodiments of the system, one or more display terminals may have the additional processing capabilities and the additional memory to perform the functions of computer 84. In such cases the functions performed by the computer

5   84 may be distributed among the display terminals, or among a network of numerous display terminals and computers, each of which has an associated data store. It should be understood that unless otherwise indicated, for purposes of the invention a network of operatively connected computers and data stores is the equivalent of a single computer with a data store operatively connected thereto.

10   Upon further use of the display terminal, the user may access certain information about patients, procedures or physicians which is stored in records in the data store of the computer 84 or other computers connected to computer 84 through a local or wide-area network. In the preferred embodiment, the stored records include information about patients. The user may select a particular patient at the display terminal. This is preferably done by the user scrolling

15   through a displayed list of patient names using "keys" presented graphically on the touch screen. The preferred embodiment of the input device includes appropriate programming of the display terminal to include a highlighting device responsive to a user bringing a finger adjacent to an area of the touch screen indicating the patient or other data selected. The selected item is highlighted to indicate it has been selected and further processing will use the

20   highlighted data. However, other input devices for selecting a patient name and other input data may also be used.

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In a preferred embodiment, the display terminal displays a patient browser window 222 shown in Figure 28. The patient browser window includes a list of patients. These patients are preferably patients that are assigned to patient rooms or other areas assigned to the display terminal through programming in the display terminal or the computer 84. Alternatively, the

5 display terminal or connected computer may be programmed to display a list of all patients in an institution at the display terminal.

The patient browser window includes a previous page button 224 and a next page button 226 that enables a user to review or "scroll" through the stored list of patient names which covers several "screens." Of course, the "buttons" are preferably areas on the touch screen produced

10 by the display to direct the user to touch an area which causes the display terminal and/or connected computer to execute a particular function.

Patient browser window 222 further includes an add/find button 228. The add/find button 228 enables a user to either add a patient to the system or to find a patient already in the system. Upon pushing the add/find button 228 the user is presented with another screen which prompts

15 the user to indicate whether they wish to add a patient or look for a patient who is already in the system, perhaps in another area of the institution. Further screens are presented based on the selection input by the user. For example if the user wishes to find a patient, a screen will request the user to input information about the patient such as the last name. The user may be provided with a representation of a keyboard on the touch screen for this purpose or the

20 display terminal may be connected to an alternative input device such as a keyboard. Upon

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completion of the input of information, the user indicates that the input is complete through the input device. The connected computers are then operative to attempt to find records related to such a patient and display the information on the touch screen.

Alternatively a user may press a sort button 230 to attempt to find a patient. The display

5   terminal and connected computers are operative to sort the list of patients by name and display the sorted list on the touch screen of the display terminal as shown in Figure 28. Touching the sort button changes the manner in which patients are displayed on the touch screen. For example, touching the sort button may cause it to change the screen so that patients are displayed sequentially by room. The designation on the sort button 230 correspondingly

10   changes as it is togged to indicate how patients are being displayed.

Alternative displays may also be provided in connection with the sort button 230 by programming the computer and the display terminal to sort and display patient data from various patient records in different ways. These may include for example sorting patients by area or ward, by physician, by gender and in other ways that are useful to users of the system.

15   Each time the sort button 230 is touched or "toggled" a new sorted display of patients or information is provided on the touch screen and the designation on the sort button changes to correspond with the method of sorting. The sort button repeats the sequence after it has been toggled through all the sort options.

Returning to a discussion the functions associated with add/find button 228, after first pressing this button the user is presented with another screen where they may indicate that they wish to add a patient. By providing this indication to the display terminal through an input, the user is prompted by screens presented on the display terminal to input the information needed

5   concerning the new patient. The user can input the information through an input device such as a representation of a keyboard on the touch screen of the display terminal, or through an input device such as a keyboard attached to the display terminal.

The display terminal and connected computers are programmed to prompt the user to input the necessary information to add at least one record for the patient to the database of the system.

10   The inputs may also include optional information about the patient as may be available. After inputting the information the display terminal prompts a user to institute an "enter" command which adds the patient and associated information to the system.

In response to the patient information being entered, the connected computers are operative to establish records for the patient in accordance with their programming. They are also

15   operative to establish programmed correlated relationships among records and/or items of stored data related to the new patient. Further in accordance with programming of the system, the system may prompt users of other types of terminals or other data input stations to generate records or input data into records concerning this new patient.

Upon finding the desired patient name in a patient window such as window 222, the user

designates that patient's record by touching the patient's name on the screen. Thereafter, the

user may remove medical items from the hook registers that are needed by that patient. When

this occurs, the number of units of each item removed from a particular hook register is stored

5   as a count in the microprocessor in each hook register. This information is then transferred to

the hook controller 72 when the hook register is polled, and is thereafter transferred to the

data terminal 76 when the hook controller 72 is accessed through the data bus 74 by the data

terminal. As a result, data representative of both the patient and the location and number of

units of medical items used for that patient is available in the data terminal.

10   When the user signs off the data terminal which is done by pushing a log-out button 232, or

selects another patient (indicating that the items for the prior patient have been taken), the data

terminal preferably transmits the information corresponding to the counts and location

numbers of the items used for the selected patient through the LAN 82 to the data store in the

computer 84 or another operatively connected computer or data store. Alternatively the data

15   terminal may be sending the data while the user is logged on. The computer 84 functions to

correlate the count and location numbers with a medical item record which indicates the types

of items stored and the location. This provides an indication of what was used for the patient.

In addition, the processor and memory in the computer 84 serve to update the record related to

the patient to indicate that the items taken were used for the patient so that the patient may be

20   charged therefore. The location records related to medical items preferably includes or may

be referenced to pricing information so that patient may be automatically billed. In addition,

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the computer 84 also updates its records concerning the number of medical items remaining in storage in each location.

The computer 84 is operable in this embodiment to maintain a continuous real time record of how many units of medical items are stored in each of the locations. If the number remaining

5   in any location has reached a lower limit, the computer 84 is programmed to provide a warning of the need to replenish the supplies at that location to an administrator terminal or workstation 86. The administrator's workstation 86 is also a computer with a processor and data store and is connected through the LAN. It has input devices such as the keyboard and mouse shown and an output device such as the screen shown. The terminal 86 may also have

10   other input and output means such as a touch screen, spoken word recognition, audio output or signal outputs connected to printers or other devices. Of course, the need to replenish the supplies may be indicated on the screen at the administrator's workstation or in other output locations including the data terminals in the area where the hook registers need to be replenished.

15   In other embodiments, the data terminal may be used to help medical technicians or nurses select medical items for patients. The computer 84 or other connected computers have associated data stores which include records which contain information on medications prescribed for patients. The computer 84 also preferably includes records related to medical procedures as well as physicians in its data store. This information may be accessed at the

20   display terminal by the medical technician or nurse who is obtaining supplies for use in such a

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procedure. By accessing the stored data records related to the procedure, the technician can read a record which includes information such as the items that are normally used in such a procedure. As a result, the technician may note these items and may remove them from the hook registers while viewing the procedure record to ensure that everything normally needed

5   is transferred to the operating room. In addition, the procedure records may be accessed in connection with a physician record related to a physician who will perform the procedure. Such records may include additional medical items that the particular physician requires to have present in an operating room when conducting a particular procedure. This may include additional medical items or particular types of medical items that the physician prefers. It may

10   also include convenience information such as the particular type of music the physician prefers to have played in the operating room during a procedure or other items that the particular physician prefers to have available.

       In other embodiments of the invention, computer 84 or other connected computers may be programmed to have in its data store, and may provide in response to a request at a display

15   terminal, a schedule of procedures in a particular hospital operating theater. This enables the medical technician or nurse participating in the procedure to locate the patient scheduled for a procedure using the display terminal, and to access therewith the records related to the physician and the medical items that will be needed for the procedure. As a result, the technician or nurse may go to the hook registers, obtain the necessary medical items and have

20   them immediately charged to the patient's account. Alternatively, if medical items which are dispensed are involved, the items may be simultaneously dispensed together. If after the

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procedure not all of the items that were originally taken were used, the items may be returned

to inventory and credited to the patient's account if appropriate. Alternatively, such items that

are partially used may need to be wasted. This is generally done by the user identifying

himself or herself to the display terminal 76 and again identifying the patient to the system

5 using the touch screen 78 in the manner previously described. Replacing the unused items

back on the hook registers 10 automatically creates a record that such items were returned and

the patient's account will be credited in the computer 84. Alternatively returned medications

and wasted items are returned to designated areas and records thereof are generated and

stored.

10 Because of the large number of records that are stored in the data store of the computer 84 and

other connected computers, a large number of reports related to inventory usage may be

generated. This can be accomplished by using database software such as Paradox® in

computer 84. Alternatively, relational database software such as Oracle® is preferably used.

Further, because the inventory at each location is monitored, messages requesting transfers of

15 inventory from areas where there are excess units to areas where there is a need can be

automatically generated by the computer and displayed at the administrator's workstation. The

computer 84 also operates to keep a running tally in the data store of what has been used by

each patient as well as what has been taken by each user and used by patients of each

physician. This further allows monitoring of usage and allow potential abuses to be

20 uncovered. The computer 84 is ideally programmed to look for patterns of dispensing activity

that have been programmed into the computer's memory as potential abuses and to display a

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report thereof at the administrator's workstation. Such potential abuses may include taking particular items at abnormally frequent intervals. The computer 84 may also be programmed to provide reports from the database concerning what particular users have dispensed during a given time period and what particular physicians have used or prescribed for patients.

5   In the described embodiment of the system of the present invention, the administrator's workstation 86 is used as a primary tool for the monitoring of inventory. The administrator's workstation is used to program the particular type of medical item stored in the location at each of the hook registers and in other types of registers in the system. This is done by creating a record for each location in the data store. The administrator's workstation is also

10   used to set the level of the minimum acceptable number of units of each item at each location so that an indication may be given of a need to replenish or transfer stock. This is programmed as a minimum for each location, and an indication is given when the minimum is reached. Further, the administrator's workstation preferably includes electronic ordering capability so that when supplies of a particular item are reduced to a particular level, a

15   purchase order to replenish the stock is sent automatically to the manufacturer. The ordering and source information is also optimally part of or referenced with the associated record with the item in the data store. As a result, the administrator's workstation is programmed so that when the quantity of an item on hand falls to a particular level, an order is communicated to the manufacturer of the needed item directly over a telephone or other data line via a modem,

20   indicating electronically the item needed, an order quantity and a date by which the items must be received. The order quantity data may be preprogrammed or may be calculated

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automatically by the computer using a program that generates the order quantity based on rate of use. Likewise, the delivery date may be a programmed time period after issuance of the order, but may also be programmed to be a rush order if the "on hand" quantity has fallen to a second lower level or if the use rate is above a programmed level.

5   The administrator's workstation may also be used to establish records for authorized users and to set varying levels of security for authorized users at different types of display terminals. Although in the described embodiment, the administrator's workstation is the primary control for the system of the present invention as shown in Figure 13, the hospital's other computer systems including the admission-discharge-transfer (ADT) system 88 and the hospital

10   information system (HIS) 90 are also connected to the local area network 82. This enables the patient data in the computer 84 to be input and output to the ADT system 88 and records relating to patient activity or other activities to be received from or stored in the HIS, which is typically the long term data storage facility related to patients. The system is also preferably connected to other computer systems in the institution such as a pharmacy system 89 which

15   provides information on medications prescribed for such patients. The system may also be connected systems in dietary and food services and in other institution areas. Each of these systems may contain multiple processors and data stores which transmit selected data to and from the LAN 82. This enables the exchange of data throughout the hospital's computers which facilitates both record keeping, patient billing and monitoring of its inventory.

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The hook registers 10 which are optimally constructed for supporting hanging items are only

one type of dispensing device that can be used with the present invention. Figures 4 through 6

reflect a further embodiment of an inventory monitoring apparatus designated by the numeral

110. Apparatus 110 is called a box register as it is optimally adapted to include storage

5   locations for holding boxes or box-like articles. Box register 110 includes an elongated

housing 112 including an upper wall 115, a lower wall 116, end walls 118 and 120, a front

wall 122 and a rear wall 124. Like housing 12 of hook register 10, housing 122 may be

fabricated from any durable material such as plastic or metal. Although not shown, it will be

understood that a clip assembly similar to clip assembly 26 of Figures 1 and 2 or a similar

10   attachment mechanism may be used to detachably fasten the housing to a wall. Alternatively,

apparatus 110 may rest on a level shelf, tabletop or reside in a cabinet. Each box register 110

is connected to a communication bus 74 (see Figure 13).

With regard to the box register, in this embodiment, an object support means is represented by

reference numeral 136 which support means may assume the form of a receptacle having at

15   least one or preferably a plurality of compartments or object storage sites 138 which are

locations wherein medical items may be stored. In this embodiment, object support means 136

is constructed as a multiple compartment, heavy gage, stiff metal wire rack including a pair of

upright truss-like end walls 139, a plurality of spaced apart storage site divider walls 140

situated between and generally parallel to the end walls 139 and a plurality of transverse

20   members 141 affixed to the end walls 139 and divider walls 140. The end walls 139 are

desirably secured by suitable mechanical fastening means 142, such as nuts and bolts or the like to lower wall 116 (as shown) or any other wall of the housing 112.

As shown in the figures, the object support means 136 is adapted to support objects 144 of substantially uniform dimensions (one of which is shown in phantom in Figures 4 through 6) in a substantially upright orientation. For example, objects 144 may be generally uniformly sized relatively thin boxes or similar packages which may contain various designated types of medical products. The object support means as illustrated is thus capable of supporting an object on four sides thereof, i.e., the bottom, back and both lateral sides of the object (see Figures 4 and 5). In this fashion, an object 144 may be removed from the object support means 136 by lifting it forward (to the right as shown in Figure 5) and/or upward. The bases of the divider walls 140 are situated at a lower elevation than the upper wall 114 of housing 12 (Figure 5) whereby the objects 144 are caused to be tilted slightly rearwardly such that the back sides of the objects maintain contact with the rear of the object support means 136.

Although the described embodiment of the object support means 136 supports the objects 144 such as boxes in substantially upright or vertical position, the present invention also contemplates rack geometries whereby objects may be supported substantially horizontally, at acute angles or in a staggered array incorporating one or more angular support orientations. Further, the spacing between the divider walls 140 need not be uniform in which case storage sites 138 of variable dimensions may be provided in the same object support means 136. Of

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course the object support means 136, like housing 112, may be fabricated of metal or from any

high strength substantially rigid plastic or other suitable material.

Box register 110 includes switch activating means 148. The switch activating means 148

includes one or more levers pivotally mounted at 150 (see Figure 6) to housing 112 in a

5   manner described hereafter. The levers 148 correspond in number to the number of

compartments 138 which are the storage locations provided in the object support means 136.

A first end of each lever 148 projects from the housing 112 into a respective one of the storage

sites 138 and a second end of each lever extends into the housing as most clearly seen in

Figure 6. The first end of each lever protrudes from the housing for a distance sufficient to be

10   contacted and displaced by an object 144 when such object is added to the object support

means 136. Biasing means later discussed return the levers to inoperative positions upon

removal of an object from the corresponding storage site.

Referring to Figures 4 and 6, as is the case with the hook registers described above, the box

registers likewise have printed circuit boards therein designated 158 one of which is shown.

15   Circuit boards 158 are mounted in the interior of housing 112. Circuit boards 158 include

printed circuitry and other circuitry components which are not illustrated or described in detail

except to the extent necessary for a proper understanding of the present invention.

Electrical sensor means are supported by and electrically connected to circuit board 158. The

sensor means generate signals indicative of the placement of an object onto and the removal of

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an object from the object support member 136. According to the preferred embodiment, the

sensor means comprises one or more discrete force actuatable switches 160 such as snap-type

internally resilient dome switches or other type electrical switches. Switches 160 are spaced

apart along the length of circuit board 158 and correspond in number to the levers 148

5   whereby the second end of each lever operates a separate switch.

The switches 160 generate real time counting signals indicative of the total inventory of objects

144 carried by the object support sites which are occupied and those which are unoccupied at

any instant in time. Thus when a lever 148 is caused to pivot in one direction by an object

that is placed into a storage location, the second end of the lever closes its respective switch

10   160. This is reflected by the solid line image of lever 148 depicted in Figures 5 and 6.

Switch 160 in turn generates a registration signal indicating that an object has been placed into

the storage location and at which storage site the object has been added.

Conversely, when an object is removed from the object support means, the biasing force from

the internal resilience of the dome switch 160 returns the lever to its inoperative position as is

15   reflected by the dash line image of lever 148 illustrated in Figures 5 and 6 whereby the switch

is open. In this position, the switch generates a registration signal which reflects that an object

has been removed from the storage location. Additionally, if mechanical switches other than

dome type or other similar switches possessing internal resiliency are employed as the   .

electrical switch means, then biasing means such as springs or elastomeric means may be

20   provided to assure that the switches change electrical condition upon removal of objects from

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the object support means 136. Alternatively, certain switch types have built-in springs which

provide the biasing force. Although dome type switches are used in embodiments of the box

registers, other suitable sensor means such as two-way toggle switches, momentary contact

switches, photo sensitive switches, capacitive or inductance sensors and the like may be

5   employed to affect the generation of additive, subtractive and object locating registration

symbols.

Figures 7 to 8 show on an enlarged scale a lever 148. The lever desirably includes a pair of

opposed notches 161, 162 which generally separate the lever into its first and second ends and,

in cooperation with mating slots provided in the front wall 122 of housing 112, establish the

10   pivotal connection 150 of the lever relative to the housing. Further, each lever 148 is

preferably provided with a downwardly sloping lip 163 at the leading edge of its first end to

facilitate insertion of the objects 144 into the storage sites 138.

The signals indicating changes in the status of the switches 160 are transmitted by wire or

other acceptable signal conducting means 164 whereupon they are detected by a signal

15   processing circuit 165 which converts the signals to an appropriate form to be received and

counted by a microprocessor 166. The microprocessor 166, like microprocessor 66 of the

hook registers 10 described above, contains software programs which record the state of the

switches each time a change is detected. The microprocessor 166 also counts and stores a

count indicative of the number and direction of changes in state as they occur. Further, the

20   microprocessor 166 includes the unique location identifying indicator associated with each of

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the storage locations in which any changes in the presence of a medical item have occurred. Alternatively, the microprocessor 166 may keep track of the times such changes have occurred.

While not illustrated it will be appreciated that the hook and box registers are preferably

5   remotely powered through the associated bus connections. In other embodiments they may be locally powered. Further, in other embodiments the registers may include LED or LCD displays on the registers for indicating the powered condition of the particular register or the fact of a change in the status of inventory items at the location. Of course suitable LED or LCD indicators may also be used for other purposes such as indicating the particular type of

10   item to be stored, that the register is in a restocking mode, or that the amount of inventory stored in the location has fallen below a critical level. This is accomplished by programming in computer 84, or programming in the other processors connected to LAN 82 to output such an indication under such conditions.

An alternative embodiment of a box register 110' is shown in Figures 9 through 12. Box

15   register 110' is similar to the previously described box register 110 except as expressly noted herein. The box register 110' includes a plurality of compartments 126 which are separated by divider walls 128. Each compartment has located therein a lever 130, which is movable about a pivot 132 (see Figures 11 and 12). The lever includes an object engaging leg 123 and a switch actuating leg 133. The leg 133 is engageable with an actuating projection 134 of a

20   switch 135. The switch 135 includes an internal spring which biases the actuating projection

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outward from the switch. The switch operates to change its electrical condition when the actuating projection is depressed.

Objects or items such as boxes holding medical supplies are stored in the compartments 126. The presence of an object in the compartment engages the object engaging leg 123 and moves

5   the associated lever 130 to the position shown in phantom in Figure 11. In this position lever 130 is in abutting relation with a stop member 152 which bounds the rear of the compartment. The stop 152 prevents the object engaging leg of lever 130 from being rotated rearward beyond the position shown in phantom. When object engaging leg 123 is in engagement with stop 152, switch actuating leg 133 depresses actuating projection 134 of switch 135 resulting

10   in the switch having a first electrical condition.

Upon removal of the box or other object from the compartment, actuating projection 134 moves outward in response to the biasing force of the internal spring as the object disengages lever 130. Outward movement of actuating projection 134 causes switch 135 to change its electrical condition. As in the earlier described embodiment of the box register this change is

15   noted in conjunction with the location information in the box register's associated microprocessor, similar to microprocessor 166.

Although the box registers shown are a single tiered rack, the object support means may comprise a multi-tiered rack or a plurality of rows and/or columns of cubicals whereby each of

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the storage sites or cubicals may be appropriately fitted with a switch actuating means such as a lever.

In the preferred form of the invention, the box registers are connected through bus 74 with the display terminal 76. The display terminal periodically reads the count information in the microprocessor 166 associated with each of the box registers and receives changes in the count information associated with each of the storage locations in the box registers.

A user may operate display terminal 76 to indicate the appropriate patient for which material taken from the box registers will be used in the manner previously described with regard to the hook registers. In addition, the administrator's workstation is used in the setup of the system to assign the particular type of medical item to be stored in each location in the box registers which is stored in a record in computer 84. However, unlike the hook registers which may store a substantial number of units of the particular type of medical item in each location, a box register is adapted to store only one such item in each location. Therefore, in some embodiments several adjacent locations in the box register are designated for containing the same type of medical item.

As is also the case with the hook registers, a user of the system who is replenishing inventory to the box registers may operate the display terminal to so indicate using the touch screen data entry device that he or she is replenishing inventory. In this case, the records in computer 84 will be updated to indicate the units of inventory added in each of the storage locations. No

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patient is credited for the items stocked in the locations and a record in the data store

concerning the number of such items on hand but not yet placed for use in a location is also

updated. In alternative embodiments, a bar code is applied on the various items stored in the

hook and box registers. A bar code reader or scanner shown schematically as 104 in Figure 5

5   is positioned in the hook and box registers so that the code on the item is read as it is placed or

removed from a location. The bar code scanner generates signals that are interpreted by

software for reading bar codes which runs in computer 84 or another terminal in the LAN 82.

A data store associated with the software includes information which correlates each bar code

identifier with a particular medical item. This provides a check that the item actually stored or

10   taken is the type that is recorded as stored in that location. If an error is made an alarm may

be given, either at the register, display terminal and/or the administrator's workstation.

Alternatively, the bar code on the medical items may be used to "set up" the system, so that

the system records the fact that a particular medical item is stored in a particular location as a

result of having read the bar code thereon as the item is placed therein. This avoids the need

15   to program the administrator's workstation with this information. The bar code scanner can be

provided in addition to the indicator which indicates an item is added or removed.

Alternatively, the bar code may be read as each item is removed from a location on a hook or

box register and the use for the patient of the item recorded directly in response to reading the

bar code signals and identifying the patient at the display terminal.

20   The information included in the data store with respect to particular items may also include a

date by which perishable items must be used. The user stocking such items in the locations

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can input such information using the input device of the data terminal. Items having a limited

shelf life are preferably stored in the box registers where the "use by" date can be uniquely

associated as part of the record for the only item in the location.

The system can also be used with other types of devices that are used to indicate that an item

5   has been taken for a patient. One such device is a manual input register where a nurse or

other medical technician manually indicates that an item has been taken.

In one embodiment a manual register is structurally similar to box register 110' except that it

does not include compartments or levers. The actuating projections of the switches are

connected to manually engageable buttons. The system is programmed so that the momentary

10   change in electrical condition of a switch resulting from depression of a particular button

represents the taking of one unit of a particular item from storage. Preferably each button is

labeled with indicia representative of the item that it is associated with.

In the case of a manual register, the nurse or medical technician ques up the patient who will

receive the items on the screen of the data terminal and touches the screen to select that

15   patient. The user pushes each button on the manual register corresponding to the type of item

taken. By pressing the button once for each unit of an item taken, data is stored in the

micropressor associated with the manual register which is representative of the particular

button location pushed and the corresponding count associated with that button. This

information is correlated with the patient record in the same manner as occurs with the hook registers and box registers.

The system of the present invention may also be used in conjunction with other types of dispensing devices. An example of such a device is an electronic lock drawer 96. The

5   electronic lock drawer may be used to store narcotics or other articles, the use of which is highly restricted and which are not suitable for storage in a hook or box type register of the type previously described. Alternatively, the electronic lock drawer may comprise a secure enclosure housing hook registers or box registers in its interior. The function of the electronic lock drawer is to hold the restricted items and provide access thereto by opening a locking

10   mechanism of the unit only when a set of predetermined conditions are satisfied. The electronic lock drawer is but an example of one of many possible storage or dispensing devices which incorporate an access control device which selectively controls access to the storage locations for medical items or which makes medical items accessible by dispensing them to a user.

15   In one embodiment of the invention the electronic lock drawer is connected to and the opening thereof controlled through an adjacent data terminal 98. Data terminal 98 is similar to data terminal 76. Data terminal 98 is connected to the electronic lock drawer 96 and is operable to unlock the lock thereto upon receipt of appropriate signals from computer 84. Of course although only one electronic lock drawer is shown in connection with data terminal 98,

20   additional electronic lock drawers may be connected thereto.

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In the preferred form of the invention, information about each type of restricted material housed in each electronic lock drawer is stored in a record in the computer 84. To gain access to these materials a user may first identify himself or herself to the data terminal in the manner previously described. Preferably for highly restricted items, computer 84 requires not only a

5   user to input an identification card and PIN number but also a second authorized user to input their coded card and PIN number. The purpose for requiring two (2) authorized users to be present to open the electronic lock drawer is so that the items removed and their disposition may be verified.

Preferably, the computer 84 has stored in the patient record, information about the medications

10   that the patient has been prescribed or authorized to be given. As a result, the user may use the data terminal to select the patient name and to request the opening of the electronic lock drawer so the user may take the medication for the patient. This is done using the touch screen of the data terminal as an input/output device. Thereafter, upon proper input of a further authorized user's verification information, the electronic lock drawer will unlock in

15   response to signals sent from the computer 84 to the data terminal 98 and from the data terminal 98 to the lock drawer 96. Thereafter, the user may remove the medication from the lock drawer in the presence of the verification user and reclose the unit. Upon the user inputting a verification input to the data terminal that the medication has been taken, the associated record of use and the charge therefore is automatically added to the patient's

20   account by the computer 84.

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It does not matter if a medication that is stored in the electronic lock drawer is not listed as one the patient is authorized to receive in the patient's records in the computer 84, the user may still access the electronic lock drawer. A user may input a request through the data terminal for a listing of medications available. In response the computer 84 outputs to the data

5   terminal a listing of the available medications and the dosages. The computer may also provide information on the location of each medication. The user may then select a particular type of medication and then input through the data terminal a request for a listing of patients which again is provided from the records in the data store of computer 84. By selecting the patient who is to receive the medication (and when appropriate providing the necessary

10   verification from a co-authorized user) the appropriate electronic lock drawer will unlock and allow access to the medication. Upon verification input to the data terminal from the user that the medication has been removed, the computer will charge the patient's account therefore by updating the patient's record. Of course as is the case with the other medical item storage locations previously described, computer 84 also operates to keep track of the inventory of

15   various items inside the electronic lock drawer 96 to assure adequate stock. The computer is also programmed to record the users and verification users who have removed items from the electronic lock drawer and the types of items taken so that any shortages or patterns of abuse may be automatically noted. Further, as discussed previously, data terminal 98 may be used to access information in the computer concerning procedures and physicians so that items in

20   the electronic lock drawer 96 may be taken to an operating theater in advance of a surgical procedure.

Of course data terminal 98 may be used like data terminal 76 to credit a patient's account for items returned from inventory as well as to indicate replenishment of inventory in the electronic lock drawer. If a narcotic substance is to be returned the computer is programmed to have a verification user verify the returns. Returns are preferably made into special one

5   way receptacles so that returned items can not be removed by unauthorized persons.

Another type of dispensing device used in embodiments of the invention are devices which provide storage for medical items under controlled environmental conditions. This is represented by a refrigerator 450 shown in Figure 13. Refrigerator 450 has an interior area which holds medical items of one or more types therein. Access to the interior area of

10   refrigerator 450 is controlled by a lock module 452. Lock module 452 controls access to the medical items in the interior area of the refrigerator. The lock module 452 is controlled from the display terminal 98. The operation of the refrigerator and the lock module is generally similar to that discussed for compartments in the electronic lock drawer 96. It should be understood that embodiments of the invention may include subcompartments within the interior

15   area of the refrigerator, and access to each subcompartment may be controlled selectively from the display terminal or from other computers within the system. The system may also have a plurality of refrigerators or other environmentally controlled chambers, and access to each may be controlled individually. This enables providing various levels of security for the different types of medical items housed in each refrigerator.

Figure 55 shows a schematic view of the connection between display terminal 98 and refrigerator 450 in a preferred embodiment of the invention. Display terminal 98 is connected to an interface module 296. The display terminal is connected to the interface module by an RS232 communications connection. The interface module 296 is connected to an interface bus

5   298. Interface bus 298 is connected to electronic lock controller 300. The interface bus 298 preferably is an RS 485 communications connection between the interface module and the lock controller.

The lock controller 300 provides signals which are operative to lock and unlock the lock module 452 on refrigerator 450. This is done in response to signals from the display terminal

10   98 which are communicated through the interface module 296. As shown in Figure 55 lock controller 300 may operate to control a plurality of lock modules on refrigerators or other storage cabinets or chambers. Interface bus 298 also may communicate with additional lock controllers. In this manner access to many refrigerators and storage devices may be controlled from a single display terminal.

15   The lock controller is further operative to communicate information concerning events to the display terminal 98. The controller communicates messages which are indicative of the locking and unlocking of lock modules on the connected refrigerators, cabinets and other devices. The controller also communicates messages concerning the accessing of the connected devices.

Controller 300 also includes a data store associated therewith and is preferably programmed to execute logic concerning the control of the connected devices. This logic may include, for example, logic associated with indications given through the indicators associated with connected devices, and whether such devices are in a locked or unlocked condition.

5   Controller 300 is also preferably programmed to control or otherwise limit the time a connected device may be accessed, and to lock the device if the device is not accessed within a programmed time after the device is unlocked. Similarly, controller 300 may be programmed to indicate alarm conditions in response to sensing specified conditions at connected devices. This may include a device remaining open for beyond a set period, or sensing that a connected

10   device is being forced open. These are examples and the controller may be programmed to have other capabilities.

It should be understood that controller 300 is preferably a computer with a processor and a data store, that is connected to computers in other controllers, in the display terminals and other computers in the system. The computers in the system being in operative connection,

15   the functions carried out by controller 300 may be accomplished by other computers in other embodiments. As is the case with other functions carried out by computer in the system, the invention encompasses carrying out the described steps and functions with any of the connected computers in the system, and the particular functions need not be carried out in the same computer or using the same arrangement of computers described in connection with the

20   preferred embodiments. Alternative arrangements and other configurations which the present

invention encompasses may be developed by those skilled in the art based on the description of the invention provided herein.

Access to the interior areas of the refrigerators is obtained by one or more authorized users as required by the programming of the system. This is accomplished in the manner similar to that previously discussed in connection with the electronic lock drawer. A signal from the display terminal 98 or other connected computer is sent to the lock controller through the interface module. The controller sends signals to the associated lock module to enable the user to access the interior area of the refrigerator and the medical items held therein.

The refrigerator 450 and lock module 452 of one preferred embodiment of the invention are shown in greater detail in Figures 50-54. As shown in Figure 50 refrigerator 450 has a door 454. Door 454 is a conventional refrigerator type door that includes a handle 456 on an exterior area thereof. Refrigerator 450 also has a body 458. Body 458 has an interior area or compartment which is maintained at a temperature below ambient temperature suitable for the type of medical items intended to be housed therein. It should be understood that the interior area of the refrigerator 450 in some embodiments may be a single storage location in which one or more types of medical items are housed. Alternatively the interior area may be divided into several storage locations. These storage locations may be open storage locations or may be subcompartments to which access is further controlled by electronic or other types of locking mechanisms. The preferred embodiment of the invention provides for records to be

maintained in the data store associated with the computer concerning the type and number of medical items stored in each storage location.

Door 454 in the embodiment shown may be swung open in the conventional manner so that authorized users may gain access to the interior area of the refrigerator. Access to the interior area is controlled by signals which are sent by the lock controller 300 to the lock module 452. The lock module is mounted on an exterior surface of the body 458 in the embodiment shown. A bolt support bracket 460 is mounted to an exterior surface of the door 454. As later discussed bolt support bracket 460 is in connection with a bolt. The bolt is normally accepted and held by the lock module 452 so as to maintain the door 454 in a closed condition. The lock module 452 is operative to release the bolt in response to an appropriate signal so that an authorized user is enabled to access the interior area of the refrigerator.

The lock module 452 includes a key cylinder 462. Key cylinder 462 is part of a manual unlocking mechanism that enables opening the refrigerator door 454 using a key. This provides an alternative way for an authorized user to access the interior area of the refrigerator in the event of a failure which prevents the interior area from being accessed electronically or alternatively for emergency or restocking purposes. The lock module 452 also includes a visual indicator 464. The visual indicator 464 in the preferred embodiment is a bi-color LED type indicator which indicates that the lock module 452 has received the signal which enables the door 454 to be opened. This may be a green color. When the lock module is in a locked condition the indicator shows red. This helps a user find the refrigerator or storage cabinet

where a requested medical item is stored. In alternative embodiments other types of indicators or additional indicators may be used.

As shown in Figure 52 the lock module 452 includes an enclosure 466. The enclosure is secured to the exterior surface of the body 458 of the refrigerator by a plurality of fasteners

5   468. In the preferred form of the invention the enclosure 466 includes an exterior cover which restricts access to the fasteners after the enclosure 466 has been installed on the refrigerator. The preferred form of the invention is retrofit to an existing refrigerator, cabinet or similar device by attaching the lock module 452 onto the exterior of the device and adjacent to the door thereof. Once installed using the fasteners 468 a cover is installed on the enclosure so as

10   to minimize the risk of tampering.

As shown in Figure 52 the lock module of the preferred embodiment includes a pawl 470. The pawl is mounted in rotatable relation about a pivot 472. A spring 474 is attached to the pawl by a pin 476. The pin and said spring are positioned relative to the pivot 472 so that the pawl 470 moves through an over center position during its operation. This enables the spring

15   474 to apply a force which biases the pawl to rotate about the pivot either in a first rotational direction or in an opposed rotational direction depending on the side of the pivot 472 on which the pin 476 is currently positioned.

The pawl 470 includes a recess 478 which receives a portion of the bolt therein in a manner later discussed. The recess 478 extends between a first leg 480 and a second leg 482 of the

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pawl 470. A sensor 484 is positioned to sense the position of second leg 482. Sensor 484 is

preferably a mechanical switch or in alternative embodiments may be an optical or a magnetic

type sensor that operates to sense leg 482 adjacent thereto. Sensor 484 is mounted on a

bracket 486. Second leg 482 includes a tapered surface 488 the purpose of which is later

5   discussed.

As best shown in Figure 54 pawl 470 includes a third leg 490. Leg 490 is bounded by a

tapered surface as shown. A lever 492 includes a tapered step 494. Tapered step 494 is

engageable with third leg 490 of the pawl 470 as shown. The tapered step 494 is part of a

releasable catch for holding and releasing the lever and the pawl.

10   Lever 492 is rotationally mounted about a pivot 496. Lever 492 is biased to rotate about pivot

496 in a counterclockwise direction as shown in Figure 54 by a spring 498. A solenoid 500 is

mounted in enclosure 466. Solenoid 500 includes an actuator rod 502 which moves upward

or downward in response to electrical signals delivered to the solenoid by controller 300. In

the preferred form of the invention solenoid 500 is a permanent magnet latching type solenoid.

15   Actuator rod 502 of solenoid 500 is in connection with a pin 504. Pin 504 is engageable in a

recess 506 in level 492. It will be appreciated that movement of the actuator rod 502 in a

downward direction as shown in Figure 54 in response to first electrical signals from

controller 300 rotates lever 492 in a clockwise direction. Because solenoid 500 is a latching

type solenoid the actuator rod remains disposed in a downward direction after the first signals are no longer supplied by the controller. When the solenoid 500 receives second electrical signals from controller 300, the actuator rod 502 rises and the lever 492 returns to the position shown in Figure 54 . The arrangement of the pin 504 and the recess 506 enable the lever 492 to be movable other than by solenoid 500. As shown in Figure 54 cylinder 462 has a projection 508 attached thereto. Projection 508 is rotatable when a proper key is inserted in the lock cylinder. Rotation of projection 508 enables the projection to engage lever 492 at the opposite end of the lever from recess 506. Moving lever 492 upward with projection 508 from the position shown in Figure 54, moves the lever in a manner comparable to actuator rod 502 of solenoid 500 moving downward. This enables the lock module 452 to be changed from a locked condition to an unlocked condition in response to either a first signal to the solenoid 500 or alternatively by a proper key inserted into cylinder 462.

As shown in Figure 53 bolt support bracket 460 includes an interior bracket portion 510. Interior bracket portion 510 is attached to an exterior surface of door 454 of refrigerator 450. The interior bracket 510 is attached to the door by fasteners 512 only the heads of which are shown. In the preferred form of the invention the interior bracket portion 510 extends adjacent and is attached by fasteners to both the front and side surfaces of the refrigerator door. Interior bracket portion 510 is attached to a bolt 514. Bolt 514 includes a pair of spaced legs 516 and a transverse rod 518 which extends between the legs.

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A cover 520 is mounted in overlying relation to the fasteners 512 so as to restrict access thereto. Cover 520 is engaged to the underlying interior bracket portion 510 by fasteners 522 only one of which is shown. As best shown in Figure 50 the cover 520 and the bracket 510 are constructed so that when the door 454 of the refrigerator 450 is closed, a surface 524 of

5   the bolt support bracket is in close abutting relation with the lock module 452. This restricts access to the bolt 514 and minimizes the risk of tampering therewith.

As shown in Figure 54 when the refrigerator door is closed the bolt 514 extends in the interior area of the enclosure 466 of the lock module 452. In the locked position the rod 518 of the bolt 514 is positioned in the recess 478 between the legs of the pawl 470. In this locked

10   position the third leg 490 of the pawl is prevented from moving in a counterclockwise direction by engagement with the tapered step 494 on the lever 492. Likewise the pawl 470 is prevented in this position from moving in a clockwise direction by engagement with a pin 526 and the sensor 484 and its supporting bracket. This prevents the refrigerator door 454 from being opened.

15   When it is appropriate to open the door of the refrigerator a signal from the display terminal 98, or other operatively connected computer or device in the system, is transmitted to the interface module 296. The interface module responds by sending an appropriate signal on the interface bus 298 to the controller 300 that is operatively connected to lock module 452. Controller responds by sending the first signal to lock module 452. The first signal causes

20   actuator rod 502 to move downward. This pivots lever 492 in a clockwise direction about

pivot 496. The movement of lever 492 disengages the catch holding third leg 490 of the pawl 470 engaged with the tapered step 494. This enables the door to be opened. As the door is opened the bolt 514 is enabled to rotate pawl 470 in a counterclockwise direction about pivot 472. As spring 474 moves into an over center relation, leg 482 pushes on the bolt to bias the door toward the open position.

The first signal from controller which activates the solenoid 500 to move the lever 492 also preferably causes illumination of the LED 464 so that a user is aware that the refrigerator door may be opened. In the preferred embodiment the LED is a bi-color LED that produces a first color indication to show that the door may be opened. The lock controller causes this open condition to be indicated sufficiently long so that the user is enabled to open the door. Once the door has been opened the signal is preferably discontinued. This is preferably done in response to the sensor 484 sensing that the leg 482 of pawl 470 has moved away from the sensor. The signal from the sensor 484 is received by controller 300 which is programmed to respond by sending the second signal to solenoid 500. This moves the actuator rod 502 upward from the downward latched position. As a result, as soon as the door is subsequently closed the door is locked. A signal of an alternative color is preferably given by the LED as the solenoid changes condition. The signal enabling closing the refrigerator lock module is generated by the controller 300 a set period, such as 30 seconds, if the door is not sensed as open. When this is done the lever 492 returns to the position shown in Figure 54. This way if the user does not open the door, the door will again become secured within a brief period of time.

In the preferred embodiment, whenever refrigerator door 454 is opened a signal is sent by controller 300 to the display terminal. A record concerning the event is made by the computer 84 and stored in the data store 85. The record concerning the opening is preferably stored in correlated relation with data representative of a user who caused the door to be opened. Other

5   data correlated with the event preferably includes all of the data associated with other types of dispensers in the system. This may include for example, the particular medications to be taken from the interior area of the refrigerator, a particular identified patient for whom the medications are to be taken as well as pricing and other information. Records concerning the numbers of medical items stored in the storage locations within the interior area of the

10   refrigerator are similarly stored in the data store and adjusted based on the data input to the display terminal. Records are also preferably stored concerning instances where a user operated the system to unlock the lock but did not open the door before the system timed out to return the lock to the secure condition.

In the preferred form of the invention of the refrigerator door the second signal is sent to the

15   solenoid 500 as soon as the door is opened. In this condition the lock module 452 is in position ready to lock as soon as the door is closed. When the second signal is sent to the lock module the lever 492 returns to the position shown in Figure 54. In this condition the pawl 470 is rotated counterclockwise from the position shown in Figure 54.

As the door of the refrigerator is closed the bolt 514 moves into the interior area of the

20   enclosure 466. The rod 518 at the end of the bolt engages the tapered surface 488 on second

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leg 482 of the pawl and begins to rotate the pawl 470 in a clockwise direction about pivot 472.

Pawl 470 moves in a clockwise direction against the force of spring 474. The tapered surface

of the third leg 490 engages and moves on the tapered step 494 of the lever 492 so as to move

lever 492 clockwise against the force of spring 498. Eventually as the bolt 514 moves inward

5   the rod 518 of the bolt moves into the recess 478 of the pawl. Thereafter continued movement

of the pawl 470 in the clockwise direction causes the third leg 490 to move past the tapered

step 494 on the lever 492. This causes the lever 492 to move downward again holding the

pawl in fixed engaged relation therewith.

As the refrigerator door is closed the leg 482 of the pawl again moves adjacent to sensor 484.

10   This provides a signal which is received at the lock controller 300. This signal indicates that

the door has been closed. The controller 300 sends a signal indicative that the door has been

closed to the display terminal. In a preferred embodiment of the invention the time of closing

of the refrigerator door is preferably included as part of the dispensing event information in

the data store along with the other associated information concerning the event. In alternative

15   embodiments of the invention the timing routine may be provided either in the controller 300,

the display terminal 98 or in the computer 84, so as to provide an indication when the door of

the refrigerator remains open beyond a set time period. Such a condition may be indicative of

a problem or tampering with the unit. Such an indication may be given either at the display

terminal and/or at other connected terminals in the system. In other embodiments of the

20   invention other approaches and techniques related to the tracking of items dispensed from the

refrigerators and other controlled environmental chambers within the system may be used.

Alternatively, lock modules may be installed on other types of cabinets or containers which house storage locations for medical items. The preferred form of the invention is suitable for use in connection with numerous types of cabinets or cupboards. Alternative forms of the lock module may be installed in interior areas of cabinets or containers to control access thereto

5   while reducing the risk of tampering with the locking mechanism. An example of another type of cabinet on which a lock module may be installed is supply cabinet 477 shown in Figure 55.

Another type of dispenser apparatus that may be used in the system of the present invention is the medicine dispenser 100 shown in Figure 13. Medicine dispenser 100 is also used for dispensing medical items that require high security such as narcotics. However, unlike

10   electronic lock drawer 96, medicine dispenser 100 is operable to dispense only the particular item requested and to restrict access to all the other items housed within the medicine dispenser. As shown in Figure 13 the medicine dispenser is connected to a data terminal 102 that is similar to data terminals 76 and 98. The operation of the data terminal 102 in conjunction with the medicine dispenser 100 is similar to the operation of data terminal 98 in

15   cooperation with electronic lock drawer 96. The difference in the use of the medicine dispenser is that in response to selection of the particular medical item (and the co-user verification if required) the medicine dispenser will provide to the user the particular medical item requested in the quantity requested. As a result, the user is not required to locate the item as is required with the electronic lock drawer. In addition, the level of security required

20   for dispense of medical items within the medicine dispenser can be varied depending on the level of security required for the particular item. As a result, for some items in the medicine

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dispenser 100 it may be necessary only to verify that the user is an authorized user. For other

substances, only selected authorized users (and co-users) will be given the substance.

The user interface of the display terminals of an embodiment of the present invention are

shown in Figures 28 through 39. When the user accesses the system using the display

5   terminal the user usually begins with the user log-in screen 302 shown in Figure 38. In the

user log-in screen the user may input a user identification code using the "buttons" on the

touch screen. The user may alternatively run their badge or other identification card through

the card reader. After input of the user identification code the user inputs their PIN. After a

user successfully accesses the system through the display terminal for purposes of obtaining

10   medical items for a patient, they are generally presented with the patient browser window

shown in Figure 28. From the patient browser window 222 a user may manipulate the

previous page and next-page buttons 224 and 226 respectively to display the patient for whom

the medical items are to be taken on the screen. The programming of the display terminal

includes a highlighting feature which serves as part of an input device of the display terminal.

15   A patient is selected by a user's finger being brought adjacent to the touch screen which

operates the display terminal to highlight the patient name as graphically indicated by the

highlighted band with a patient name in Figure 28. Upon touching the patient name in

addition to being highlighted, the patient name is also shown at the top of the screen. This

serves to identify this particular patient to the system as the one for which medical items are

20   being taken.

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From the patient browser screen 222 a user is enabled to remove items from the hook or box

registers, in which case the items will be automatically indicated as taken for and charged to

the patient. Similarly if an item taken for a patient is to be returned to a hook or box register,

highlighting the patient name on the patient browser screen and replacing the item on the hook

5   or box register results in the patient's records and account being credited for the returned item.

From the patient browser screen 222, more information concerning the selected patient may be

obtained by the user touching a patient info button 234. Touching the patient info button 234

causes the display terminal to display the patient information window 236 shown in Figure 29.

10   Patient information window 236 shows information about the patient. This can include vital

statistics, the name of the treating physician, allergies that the patient may have and other

information. In addition, the patient information window 236 also shows the assigned location

of the patient in the facility. The patient information window 236 includes a close button 238

which a user presses to return to the patient browser window 222.

It should be noted that the patient browser window 222 as well as the patient information

15   window 236 include a help button 240. The help button 240 is pressed by a user when they

wish to obtain more information about using the system features that are currently accessed on

the displayed window. The display terminal and the connected computer systems are

programmed appropriately to provide instructions concerning the type of help most commonly

needed when accessing the particular patient windows. This makes the system easier to use

20   and reduces the amount of training required before user may effectively operate the system.

From the patient browser window a user may choose to review the medical items that have

been taken for the selected patient. To do this a user touches a patient usage button 242. In

response to selection of the patient usage button, the computer and display terminal are

operative to display a patient usage browser window 244 shown in Figure 30. The patient

5   usage browser window is operative to show medications and other medical items that have

been taken for the patient as well as the amount and time that each medical item was taken.

The patient usage browser window also includes a return button 246 and a waste button 248.

The return button is selected in situations where a medication that has previously been taken

for a patient is returned without being administered. The return button is used in situations

10   where the returned item is a controlled substance such as a narcotic or is another item that

cannot be freely dispensed or used for another patient. Selecting the return button generally

enables a particular return drawer mechanism to open into which the medical item may be

returned. By highlighting a particular dose of medication on the patient usage browser screen

and completing a return transaction, the status of a medication may be changed from taken to

15   return.

The waste button is used in situations where an item taken for a patient is to be returned in

whole or in part and it cannot be used for another patient. This includes situations where only

a portion of the medication is delivered and the balance is waste. Selecting the waste button

248 also preferably opens a return drawer into which the wasted item may be deposited. The

20   patient's records are simultaneously adjusted accordingly in the patient records and on the

patient usage browser window.

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The operation of the return and waste buttons 246 and 248, respectively, along with a return

drawer used in the preferred embodiment is shown in copending U.S. Application Serial No.

08/679,203 filed July 12, 1996, the disclosure of which Application is incorporated herein by

reference.

5   The patient usage browser window 244 also includes a discrepancy button 250. The

discrepancy button is used in connection with dispensing medications as well as with the return

and wasting of medications. The discrepancy button 250 is used by a user to indicate to the

system that something requested was not provided, or that an indication previously input to the

system is not accurate. Pressing the discrepancy button causes the display terminal to display

10   a window appropriate to indicate the nature of the discrepancy. The patient usage browser

window 244 also includes a previous page button 224 and a next-page button 226 similar to

those previously described for scrolling through the information pertaining to the patient.

Window 244 also includes a help button 240 and a close button 238 like those previously

described. The close button is used when the user is finished with the patient usage browser

15   window and wishes to return to the patient browser window 222.

Patient usage browser window 244 further includes a trade name/brand name button 252.

Button 252 is operative to change the names of the medical items displayed on window 244

from the trade name to the brand name and vice versa. Button 252 may be toggled from one

name for an item to the other. This feature is available in a number of windows and is useful

for a user who may need to compare the brand name(s) of a medical item to the generic name and vice versa.

Trade name/brand name button 252 is enabled to provide this feature at the display terminals responsive to records stored in data store 85 in which the generic names and brand names for

5   medical items in the system are stored in correlated relationship. The data store 85 further includes in its records data indicative of whether each particular name for the medical item is the generic or brand name. Multiple brand names corresponding to generic names may be stored and displayed on the screen. This feature enables a user operating the display terminal to toggle the display back and forth between brand name and generic name. In addition, the

10   display terminal indicates in a header above the drug information whether the generic or brand name information is being provided on the screen. Button 252 changes to the opposite designation to that being displayed when it is toggled. This informs a user that they can change from, for example, the generic name shown in window 244 to the trade name or brand name by touching button 252 on the touch screen.

15   From the patient browser window 244, a user is enabled to review medications available for dispense to a patient. To review the medications that have been prescribed for a particular patient, a user highlights the desired patient name by touching the name in the patient browser window 222 and touches a med order button 254. Touching med order button 254 causes a med order browser window 256 shown in Figure 31 to be displayed. Med order browser

20   window 256 includes information about the medical items that have been prescribed for the

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patient including information such as dosage and frequency of administration. The med order browser window also contains other information such as the route by which the medication is to be delivered to the patient such as orally or through intramuscular injection. The med order browser window 256 also includes the date and time information that the medication was

5   started. If a medication has been stopped, this may also be indicated.

If a user wishes to take a medication for a patient, the user may highlight the medication on the med order browser window and touch a dispense button 258. By touching the dispense button on the touch screen, the display terminal is operative to cause the electronic lock drawer, medication dispenser or other apparatus in which the particular medication is held to

10   operate to make the medication available to the user. The med order browser window 256 further includes an info button 260. Info button 260 may be pressed to display additional information about the particular medication which has been highlighted. This may include particular information that the physician wished to include concerning the administration of the medication. Alternatively the information button may access information stored in the data

15   store 85 concerning the particular medication itself including information such as possible side effects, drug interaction data and the like.

The med order browser window 256 further includes a trade name/brand name button 252 which may be used to change the displayed drug identification information from generic to brand name and vice versa. Window 256 also includes a help button 240, a previous-page

20   button 224 and a next-page button 226, all of which function in the manner previously

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described. The med order browser window 256 further includes a close button 238 which a user may select to return to the patient browser window 222.

Instead of reviewing medications that have been specifically prescribed for a patient, a user from the patient browser window 222 may choose to dispense medications and medical items

5   from a listing of all medical items which are available in the area adjacent the display terminal. To accomplish this a user selects a supply button 262 on the patient browser window. Selecting the supply button 262 causes a supply browser window 264 to open on the screen of the display terminal. The supply browser window is shown in Figure 32. Supply browser window 264 includes a listing of medical items which are available for dispense. A user may

10   select one of these substances by touching the screen adjacent to the item desired. If it is a controlled substance such as a narcotic, the display terminal and associated computers are programmed to require heightened security such as two authorized users to log on to the display terminal before a dispense may be made as was previously discussed.

A user dispenses medical items from the supply browser window 264 by highlighting the item

15   desired and selecting the appropriate select quantity button 268. The select quantity button indicates how many of one particular medical item the user desires to have dispensed. The user then selects the dispense button 258, which is operative to cause the display terminal to actuate the appropriate device for dispensing the requested quantity of item.

The supply browser window 264 also includes the trade name/brand name toggle button 252 previously discussed. The operation of button 252 is demonstrated with regard to an alternative supply browser screen 270 which is shown in Figures 35 and 36. Alternative supply browser screen shows only one medical item so as to make more apparent the operation

5   of button 252. In Figure 35 button 252 is set to display the generic name of the medical item, in which case the single medication shown is displayed by its generic name and button 252 indicates that it is available to be toggled to the trade name. Toggling button 252 changes browser screen 270 to the format shown in Figure 36 in which the trade or brand name of the medication is displayed, and button 252 indicates that it is available to be toggled to display

10   the generic name. Of course, for medical items for which there is only a generic name, the data base records stored in the data store 85 in connection with computer 84 or other connected computer in the system may be arranged to indicate that there is no corresponding brand or generic name when this situation arises. Likewise for items which have multiple brand names, the display terminal is preferably operative to provide all the brand names

15   associated with the item.

The data store of the system also includes pricing information for both brand and generic medical items. The data terminal and connected computers are operative to charge the patient's account for the type of item which is dispensed. This is determined responsive to the name for the item displayed on the display terminal when the dispense is made.

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In some situations the name type for an item prescribed for a patient may not be available in the dispensers connected to the display terminal or otherwise available in the area adjacent the display terminal. The display terminal or connected computer may be programmed responsive to a request to dispense an item by a trade or generic name which is not available, to indicate

5   on the display terminal that the item is available under an alternative name. The user in response to receiving such an indication, may toggle button 252 and dispense the item under its alternative name. In such situations, the user may also consider this a discrepancy which should be recorded in response to the user prompts generated in response to selecting the discrepancy button 250. The ability of the system to track items by both trade or brand names

10   and generic names may avoid needless delay in providing medical items.

The supply browser window 264 also includes a physician/route/site button 272. Selecting button 272 causes a physician/route/site browser window 274 to be displayed. A sample physician/route/site browser window is shown in Figure 37. If there is already a physician associated with the dispense of the medication selected in window 264 to the particular patient

15   shown in that window, then a physician button 276 will be highlighted in window 274. If the physician button 276 is highlighted, then a user may press a route button 278 which will cause the display terminal to display a further window which indicates the route that the physician has prescribed for the medication to be administered to the patient. A site button 280 may be selected to review the site on the patient that the physician has prescribed for the medication to

20   be administered. If, however, when the user accesses window 274, the physician, route or site buttons are not highlighted, no associations related to these parameters have been made.

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To associate a dispensing order with a physician, a user may select the physician button 276 to display a list of physicians on the screen. The user may then select a physician which causes physician's name to be highlighted. The user may thereafter select the route button 278 which causes a listing of route information, as shown in Figure 37, to be displayed. The user may

5   then select a particular route by highlighting it. Thereafter, if appropriate, the user may select site button 280, which causes a list of sites to appear. The user may select a site. To save all the associated information that has been input, the user highlights an accept button 282. After reviewing the information in window 274 or establishing a new relationship, a user may close window 274 by selecting close button 238 and returning to patient browser window 222.

10   As previously discussed, a further advantage of a preferred embodiment of the present invention is that medical items to be used for a particular medical procedure are stored in correlated relation along with a designation of the particular medical procedure in the data store. These collections of medical items are called "kits" in the preferred embodiment of the invention. Kits may be established by the operator of the system in accordance with the

15   particular needs of the system. Kits may include particular collections of medical items for a particular procedure that is scheduled for a patient. Alternatively and in addition, kits may also be a collection of medical items used to conduct particular types of frequently-administered medical tests, such as diagnostic tests.

In accordance with a preferred embodiment to the invention, from the patient browser window

20   222 a user may review kit information by selecting a kit button 284. Selecting the kit button

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causes a kit browser window 286 shown in Figure 33 to be displayed on the display terminal.

The kit browser window shows kits that have been prescribed for the selected patient. In

addition, the kit browser window preferably displays a listing of other available kits. A user

may select a particular kit by touching the kit on the touch screen. If the user wishes to learn

5   what items are in the highlighted kit, they may select a kit info button 287. Selecting the kit

info button causes the display terminal to display a kit information window 290 shown in

Figure 34. Kit information window 290 shows the name of the kit and all of the items that are

included in the kit. In addition the kit information window shows how many of the particular

items in the kit are available for dispense from the storage locations adjacent or attached to the

10   display terminal. The computer may alternatively be programmed either in the kit information

window 290 or when a kit is dispensed, to indicate to a user where items that are not available

in the area adjacent the display terminal may be obtained. The inventory tracking features of

the invention enable providing the user with the nearest location the needed item is stocked.

After reviewing the information concerning what is in the kit, the user may select a close

15   button 238 on kit information window 290 to return to the kit supply browser window 286.

The user may select the dispense button 258 in window 286. Selecting the dispense button is

operative to cause the display terminal to dispense or make available all the items in the kit

together. In addition, the display terminal and connected computers may be programmed to

indicate in response to selection of the dispense button that the user is required to manually

20   take from open storage certain medical items that may be required for the kit which are not

dispensed. This is accomplished through appropriate programming of the records in the data

store when the kit is established. Of course, selecting the dispense button 258 not only causes all of the items in the kit to be dispensed or otherwise made available, but such items are also charged to the patient's account.

The storage of information in the data store concerning kits, which is data representative of

5   collections of items stored in correlated relation for a particular procedure or activity, is highly useful. It provides for automatically dispensing the needed items together where possible, and provides a visual reminder to the user of the system of all the things that are needed to accomplish a particular medical procedure. This avoids mistakes and saves time. Of course, after reviewing the kit browser window 246 and/or dispensing a kit, a user may return to the

10   patient browser window 222 by selecting the close button 238.

After a user has completed dispensing transactions for a particular patient, they may take medications for another patient by highlighting that patient on the patient browser window 222 and repeating the steps for that patient in accordance with the procedures previously discussed. The system is programmed so that a user is free to obtain items either from dispensers of

15   various types in response to dispensing requests, to manually remove items from hook or box register locations or to take items from accessible storage locations. For those items which are controlled substances such as narcotics, dispensing transactions cannot be completed until a second appropriate user or witness enters their identifying information to the system to witness the dispensing transaction. As previously discussed, dispensing transactions which are

20   conducted by a user or a witness are recorded by storing the information on what was

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dispensed in correlated relation with the user's record as well as with the patient's record in the data store. Of course, the system may be programmed to correlate and store other types of information as well.

When a user is finished with dispensing medications for patients, they may select the log-out button 232 at which point the display terminal waits to be accessed by another authorized user.

It should be noted that the patient browser window 222 also includes a restock button 292 and a retrieve button 294. The restock button 292 is used in connection with restocking the system. Certain system users have correlated records in the data store that enable them to restock the system. Such a user, when they access the data terminal may also select the restock button 292 and cause the display terminal to display windows upon which a user may indicate which items have been restocked, and the available quantities. The person restocking preferably does this by accessing the dispensers and electronic lock drawers using keys or access methods which are not controlled through the display terminal. However, in other embodiments the display terminal may be used for opening the dispensers and electronic lock drawers for restocking purposes as well. Once the user restocking the items has completed the information associated with the restocking activity, they can log out of the display terminal by selecting button 232.

Retrieve button 294 is likewise used by a selected group of authorized users. The retrieve button is used to enable certain selected users who have authority to access medications that

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have been returned or wasted and which are stored in a particular retrieve drawer. Such an

authorized user has an associated record in the data store that authorizes them to do this and

when such a user authorizes the system and selects this button, the retrieve drawers may be

opened. To enable the user to retrieve such items, the process of retrieving returned or wasted

5   medications is described in copending U.S. Application Serial No. 08/679,203 filed July 12,

1996, the disclosure of which is incorporated herein by reference. Again, after a user has

conducted a retrieve activity, they may exit from the system by selecting the log-out button

232.

Embodiments of the invention may also be used in connection with medical items which are

10   "non-itemized". Such items are generally not counted and not tracked to patients so there is

no record maintained in the data store that such an item was taken for a particular patient.

Likewise, in most cases the item is not billed to the patient. However, in some cases items

may be tracked to a patient but not billed. Generally non-itemized items are stored in open

storage locations. Any authorized person is free to take these items for patients or for a

15   medical condition that the user may be experiencing.

It is important however that supplies of non-itemized or otherwise uncounted medical items be

maintained at adequate levels. Because the system does not track the taking of such items it is

possible for such items to fall below desired levels or to be completely depleted before an

appropriate person is notified to replenish the quantity of medical items in the non-itemized

20   storage location. Significant time periods may elapse before the supply is replenished.

An embodiment of the present invention operates to minimize the risk that non-itemized medical items will be depleted. This embodiment enables a user, upon noticing that the level of items in storage in a storage location has fallen below a desired level, to indicate to the system this condition. An appropriate function within the medical facility is notified and the

5   storage location is restocked. To achieve these results storage locations for non-itemized medical items are physically marked to indicate a level at which restocking should be performed. Generally this may be accomplished by placing a physical marking in the storage location, such as a line on a shelf. As items are removed from the shelf for example from left to right, a user knows that when the number of items remaining is "below the line" there is a

10   need to indicate this quantity condition to the system. This level in some instances may be referred to as a "minimum" acceptable level of supplies. Alternatively, the level may be referred to as a "par value" which means the average desirable quantity of medical items to have available. Where the levels are set and how they are characterized depends on the medical item and the needs of the users of the system.

15   As shown in Figure 38 a user approaching the display terminal is presented with the user log-in screen 302. In the embodiment of the invention shown the user may press the "non-itemized button" 304 without logging into the system. When the user presses the non-itemized button the non-itemized inventory window 306 shown in Figure 39 is presented on the screen of the display terminal. Non-itemized inventory window 306 presents a listing

20   of the non-itemized inventory items as well as their locations.

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The user, after accessing the non-itemized inventory window, may highlight a particular

supply by touching the touch screen in the area where the item is listed. The user may

indicate the particular quantity condition that the user has noted for the supply. For example,

if the supply is below the desired level the user may touch the "below minimum button" 308

5   on the touch screen. Pressing this button causes a signal to be generated and a message to be

transmitted to the data store that the items in this particular storage location are below the

minimum. The system is preferably programmed so that this information is also presented in

the form of a message or report to the function or department in the medical facility

responsible for restocking the storage location. In response a restocking of the particular

10   storage location with the corresponding items is performed. Similarly if a user notes that a

particular supply position is out of stock, the user may press the "out of stock button" 310 on

the non-itemized inventory window 306. Pressing the out of stock button causes a different

signal to be generated and transmitted to the data store, as well as to the restocking function.

Preferably the system is programmed so that the restocking function is notified on a more

15   urgent basis to replenish the items in the storage location than in the case of a below minimum

situation. When the user is done using the non-itemized supply window they may return to the

user log-in screen 302 by pressing the "close button" 312.

As shown in Figure 39 the non-itemized inventory window 306 also includes a "trade/brand

name button" 314 which may be used to change the supplies from brand to generic name and

20   vice versa responsive to pressing the button. Likewise, a "position/name button" 316 is

provided so that the window 306 can present the non-itemized medical items either in order by name or by supply position. This facilitates finding a desired item quickly.

The system of this embodiment is preferably operable to determine the locations where supplies need to be replenished and to provide the users who perform the restocking function

5   with information on the types of medical items and the quantities which must be added to the storage locations. In the case of non-itemized inventory a restocking user who has replenished a storage location by adding a quantity of medical items thereto, may highlight the particular item and location and indicate that it has been restocked by pressing a "restock button" 318. Often the restocking function will replenish all of the storage locations. When this is done the

10   restocking user may indicate that all the non-itemized locations have been restocked by pressing a "maximum all button" 320. The use of this feature saves considerable time for a restocker who would otherwise be required to highlight the various items either individually or in groups and change their status.

In an alternative embodiment to the invention, the actuation of the restocked button 318 and

15   the maximum all button 320 may be limited to users who are authorized to carry out a restocking function as indicated by the data in the data store. In a system configured to be operated in this manner, a restocking user would be required to log onto the system using the user log-in screen 302, as must be done for inventory that is itemized and tracked to patients. Once the user with restock privileges has logged in, the appropriate buttons may be touched to

20   indicate that the quantity conditions at the storage locations have been changed.

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The operation of the described embodiment of the system for handling non-itemized medical items provides a significant time savings for system users. Handling items as non-itemized is particularly appropriate for common, low cost items which are often accessed and are not billed to patients. Implementing this approach avoids the need for users to go through

5   additional and unneeded steps to take such items. Of course, if the institution operating the system decides that items in non-itemized inventory should be tracked to patients, counted or billed, such items may be reclassified in the data store. The result would be that such items would be removed from the non-itemized inventory listing and included in the listing in the supply browser window 264 and other appropriate windows which show medications which

10   are tracked and billed.

A further alternative embodiment of the system for tracking and dispensing medical items is shown in Figure 40. This alternative system generally indicated 322 is similar in all respects to the system described with reference to Figure 13, except as otherwise indicated. The system 322 includes a computer 324 which includes therein or is otherwise operatively

15   connected to a data store, schematically indicated 326. It should be understood that computer 324 and data store 326 are shown schematically and that embodiments of the invention may consist of several operatively connected computers and data stores.

The computer 324 is connected through a network 328 to other devices and systems. Network 328 may be a local area network (LAN) within the facility, or wide area network. Network

20   328, as in the previously described embodiment, is connected to the facility's admission,

discharge and transfer (ADT) system schematically indicated 330. Likewise, network 328 is

connected to the facility's information system (HIS) 332 and the facility's pharmacy system

334. Preferably, as in the previously described embodiment, all of these systems within the

facility are enabled to exchange information and function in cooperation with other devices

5   connected through the network 328.

System 322 also includes one or more administrator's workstations 336. The administrator's

workstations are similar to those in the previously described embodiment of the system. The

system also includes a plurality of display terminals 338, only one of which is shown. Display

terminal 338 is similar to the display terminals 98, 76 and 102 previously described, except as

10   otherwise indicated. Display terminal 338 includes a touch screen 340 which serves as an

input device and an output device. The display terminal also has a fold down, alphanumeric

keyboard 342 which serves as an input device. Display terminal 338 also preferably includes

a card reader, a processor, as well as its own local data store, and interfaces connecting the

display terminal to both the network 328 and the other devices to which it is connected.

15   The display terminal 338 is in operative connection with storage devices for storing medical

items. An electronic lock drawer 344 is connected to the display terminal 338. Electronic

lock drawer 344 is similar to the electronic lock drawer previously described, except as

otherwise indicated. The electronic lock drawer includes a plurality of storage locations for

medical items and includes electrically actuated locks for selectively controlling access to the

storage locations. The locks are opened in response to signals sent from the display terminal 338.

A refrigerator 527 is also connected to display terminal 338. Refrigerator 527 includes a lock module thereon and operates in a manner similar to the refrigerator 450 previously described.

5 The refrigerator has an interior area which includes one or more storage locations for storing medical items therein. A lock module on the refrigerator selectively controls access to the interior area of the refrigerator in response to one or more signals sent from the display terminal 338.

A dispenser 346 is also connected to display terminal 338. Dispenser 346 holds a plurality of

10 different types of medical items in storage locations therein, and selectively dispenses medical items from its storage location in response to signals from the display terminal 338. Dispenser 346 may be similar to dispenser 100 or preferably may be a dispenser of the type shown in co-pending U.S. Application Serial No. 60/045,137 filed April 30, 1997, the disclosure of which is incorporated herein by reference.

15 The alternative system 322 further includes a reading device 348 in operative connection with the display terminal 338. The reading device 348 is preferably a device for reading machine readable indicia such as bar code. The reader device further preferably includes a display screen or other output device 350, as well as an input device 352 in the form of a keypad with alphanumeric designators and function buttons, through which a user may enter inputs.

The preferred form of the reading device 348 includes its own internal processor and memory. The memory includes programmed instructions referred to herein as configuration data, which controls the operation of the processor and the components which make up the reading device. The configuration data includes data which enables the reading device to recognize and

5   interpret machine readable indicia. It also preferably includes information on authorized users of the system and their corresponding personal identification numbers (PIN). The configuration data preferably further includes information on storage locations and the location designators for locations associated with the display terminal 338, as well as the medical items stored in those locations. The configuration data also preferably enables the reading device to

10   receive instructions and to generate transaction messages. The transaction messages are sent to the display terminal, and are then forwarded to the other components of the system. The reading device 348 also preferably includes a storage location or cradle schematically indicated 354. The cradle 354 provides a place for holding the reading device when it is not in use. In addition, placement of the reading device in the cradle may be used to initiate certain activities

15   by the reading device as hereinafter explained.

This alternative form of the system of the invention is described in connection with Figure 40. Storage locations are preferably labeled with machine readable indicia corresponding to the location designator established in the data store for the particular storage location. Such machine readable indicia identifies the location and also preferably the medical item type to be

20   stored in the location. As will be appreciated from the description of the operation of the system which follows, including machine readable indicia representative of the medical item

type enables the system to verify the data in its data store concerning the type medical item stored in a storage location. This feature may also avoid the need for the data store to include information on the medical item types stored in certain storage locations, because such information can be read directly.

5　　A schematic view of an open storage shelf indicated 356 is shown in Figure 40. Shelf 356 holds medical items thereon which may be removed by a user of the system. Shelf 356 includes machine readable indicia 358 thereon which identifies the particular storage location. The indicia may also include data representative of the medical item type stored therein.

Preferably the machine readable indicia also includes human readable indicia to advise a user

10　what is stored in the storage location. This is preferably done using a label, an example of which is indicated by label 360 shown in Figure 41. Label 360 is an example of a position only label which includes machine readable indicia which indicates only the storage location and the medical item stored therein. Label 360 is an example of the type of machine readable indicia used on storage shelf 356 and indicated by machine readable indicia 358 thereon.

15　Further machine readable indicia are also applied to the storage locations in this alternative embodiment of the invention. Such further indicia is explained with reference to storage shelf 362 shown in Figure 40. Storage shelf 362 includes machine readable indicia 364 which like indicia 358, identifies the storage location. It should be noted that indicia 364 is positioned so as to be accessible only when the medical items stored on shelf 362 have been reduced to a

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level such as the below par value or below minimum, where restocking is desirable. Of course storage shelf 362 may be marked in an appropriate manner as shown to indicate when the quantity of medical items stored thereon has fallen to a level where an input should be given to the system to replenish the location. Storage shelf 362 also includes further machine readable indicia 366. Further indicia 366 is preferably positioned to become accessible when the last of the medical items stored on the shelf is removed. In alternative embodiments further indicia 366 may be placed in other locations however.

Figure 42 shows a label 368 which is used to indicate an out of stock condition at a storage location. Label 368 corresponds to indicia 366 shown in Figure 40 on storage shelf 362. Label 366 indicates the storage location as well as the item stored therein, as well as the quantity condition that the item is out of stock at that location.

As further shown in Figure 40, storage shelf 362 includes further machine readable indicia 370 thereon. Such machine readable indicia 370 is preferably used by a user restocking the shelf 362 to provide an input that the particular medical item type stored in the location has been restocked. Figure 43 shows an example of a label with indicia which indicates that a particular storage location has been restocked with a medical item. Such labels are preferably positioned in locations which are inconspicuous, and which can be read with the reading device 348 when the storage location has been restocked.

It should be understood that storage shelves 356 and 362 are shown as shelves for storage of non-itemized inventory. Because non-itemized inventory items are not tracked to patients, there is a need in some embodiments of the invention to distinguish such inventory from other open shelf type inventory that may need to be tracked. It is therefore preferable to provide visually distinguishable characteristics for labels or other machine readable indicia used for non-itemized inventory to distinguish them from indicia used in connection with medical items which must be tracked. One manner of accomplishing this is to use different colored labels for itemized and non-itemized inventory.

For itemized inventory for which each unit is counted and/or tracked, it is desirable to provide separate machine readable indicia which can be used to indicate that a particular storage location is exhibiting a quantity condition corresponding to a level requiring replenishment, but has not yet reached the level of being totally depleted. To accomplish this for itemized medical items, machine readable indicia which indicates the "below minimum" or "below par value" quantity condition are placed adjacent to the storage locations. An example of such a label used for accomplishing this function is indicated 374 in Figure 44.

It should be understood that while the foregoing description discusses holding non-itemized inventory in open shelf locations, in other embodiments of the invention non-itemized inventory may be held within enclosures or other containers. Such areas may include cabinets with shelves for holding such items as well as environmentally controlled chambers including

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refrigerators, high temperature chambers, low humidity chambers and other types of containers where medical items may be stored prior to use.

In the alternative form of the invention described with reference to Figure 40, certain storage locations are controlled by an access control device such as the locks of an electronic lock

5   drawer or refrigerator. Storage locations are also marked with machine readable indicia of the type previously described. Figure 45 shows an example of a single drawer 376, within electronic lock drawer unit 344. Drawer 376 includes a storage location 378 for storing medical items therein. As shown in Figure 45, the storage location includes machine readable indicia in the form of a label 380, which indicates the location designator for the storage

10   location as well as the medical item type stored therein. Storage location 378 further includes further machine readable indicia in the form of a label 382, which is an out of stock label. As shown in Figure 45, the out of stock label 382 is positioned on the bottom surface of the storage location, so that it becomes accessible when all the items have been removed.

It should be understood that for storage locations which hold medical items which are counted

15   and/or tracked by unit, the computer may calculate, and the data store may include, data representative of the number of units remaining in each storage location. However, it is also possible to include among or on the units of medical items machine readable indicia, which can be used to indicate that the number of medical items in the storage location has fallen to a level where restocking is required. Such indicia may be on the item which the user can scan

20   when the item is taken. Alternatively, the indicia may be on a card or other divider placed

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between the medical items. In either case when the indicia is scanned the system is apprised

of the number of units remaining at the location.

In the alternative form of the invention not only are each of the storage locations marked with

machine readable indicia, but the access control devices themselves, such as the electronic lock

5   drawer or refrigerator, are marked with unique indicia. In the case of electronic lock drawer

344 this may include labeling the entire electronic lock drawer unit with a single machine

readable indicia. Alternatively, it may include labeling each drawer (or storage location within

a drawer or other interior area) in the electronic drawer unit with such indicia. This indicia

may be used in a manner later explained to selectively open the electronic lock drawer unit. Of

10   course a similar approach may be taken with refrigerator or other devices which house medical

items.

The alternative form in the system 322 shown in Figure 40 includes a report generating means

which is schematically indicated by a printer 384. Printer 384 may be positioned at a nursing

station, restocking staging station or other location that is convenient for users of the system.

15   It should be understood that while only one printer is shown, additional printers or other types

of report generating means may be included in the system. The printer 384 is in operative

connection with a computer 386. Computer 386 operates in accordance with programmed

instructions and includes an internal memory or data store therein. Computer 386 is in

operative connection with the network 328.

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The printer 384 is operative responsive to the programmed instructions stored in connection with the computer 386 to generate reports schematically indicated 388. The reports produced by the report generating means preferably include both human readable indicia as well as machine readable indicia. As later discussed in detail, reports which include such indicia may

5   be produced for use in dispensing medications as well as for restocking the storage locations of the system.

In the alternative form of the invention, storage locations may be labeled with other types of machine readable indicia. Such indicia are recognized by the reader in accordance with its configuration. In certain embodiments "prefix" labels or similar indicia may be applied. Such

10   prefix labels indicate a particular quantity condition. The prefix labels indicate the quantity condition exists at the location corresponding to the next location indicia read. In the preferred form of the invention the quantity condition associated with the prefix label takes precedence over any quantity condition associated with the next label that is read, provided the next label is read within a set time which is established in the reader configuration.

15   For example, a single prefix label indicating a "restocked" quantity condition may be placed adjacent to several storage locations. A restocking user may indicate that he or she is filling an empty storage location by reading the "restocked" prefix label, and then reading the "out of stock" label or "below par" label at the location within the set time. Because the prefix takes precedence over other quantity conditions, the other quantity condition in the label is

disregarded and the reader stores data which indicates that the particular storage location has been restocked.

Other types of prefix labels indicating other types of quantity conditions may be placed adjacent to storage locations and used in a similar manner. Such other prefix labels may be
5   associated with quantity conditions such as "below par", "out", "out of stock, emergency restocking needed", "one unit taken" or other quantity conditions. Reading a prefix label indicates the quantity condition for the next label read which includes a location identifier (provided it is read within the set time) regardless if there is a different quantity condition indicated on the label that includes the location identification data.

10 In the alternative form of the system the configuration of the reader determines a quantity condition being indicated based on a hierarchy. A quantity condition indicated by a prefix label is at the top of this hierarchy. Thus, prefix label data when read takes precedence over any other quantity condition that may be included in indicia subsequently read by the reading device or established through the configuration of the reading device.

15 The second tier in this hierarchy is preferably the "out" quantity condition. Thus, if a different quantity condition is established by the configuration of the reader, and a label indicating an "out" condition at a storage location is read, the reader configuration will interpret this as an "out" indication at that location. However, if a prefix label had been read

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first, the quantity condition associated with the prefix label would be indicated because prefix labels are higher in the hierarchy.

As later explained, the reader includes data representative of authorized users. The data representative of certain authorized users has stored in correlated relation therewith a quantity condition that the user normally reports or performs. For example, if a user normally takes medications for patients, the quantity condition associated with that user data would be "one taken". As a result, when that user is "signed on" the reader, and reads a label which includes location indicia, the configuration of the reader will interpret the reading of the location indicia as indicating the "one taken" quantity condition at that location. This would be true unless a "prefix" or "out" label had been scanned.

As later discussed, users may have various quantity conditions associated with them. In addition to "one taken" for users who normally take items, restocking users may have the "restocked" quantity condition associated with their identifying data. Other types of quantity conditions can be assigned to particular users who normally perform the act or function associated with their associated quantity condition.

The configuration of the reader preferably provides a time period for a user who has identified himself or herself as operating the reading device, to begin reading location indicia where the quantity condition associated with the user has occurred. If the reader "times out" without

location data being read, the next read location will not be treated as having the quantity condition associated with the particular user.

The lowest level in the hierarchy is one where no user with an associated quantity condition has indicated that he or she is operating the reader, and no "out" or "prefix" label has been

5   read. At this lowest or default level, the configuration of the reader interprets the reading of indicia which includes a quantity condition and location as the condition existing at the location. If the indicia does not include a quantity condition, and only location data is read, the configuration of the reader interprets that as a "below par" quantity condition at the particular location. This is done provided the location is one where the medical items are not

10   counted as indicated by the system configuration. If the location indicia read is of an improper type such as in a dispenser where "below par" is not appropriate, the configuration causes an "error" signal indication to be given. Such error indications are also given when any operation of the reading device is attempted which is incompatible with the configuration of the reader.

15   In operation of the alternative system shown in Figure 40, the reading device 348 is operated by users of the system to accomplish dispensing and restocking activities. In a first form of this alternative embodiment the reading device is operated to perform activities comparable to those previously described as accomplished using the display terminal. The reading device includes the screen 350 which serves as an output device, as well as input devices 352, which

20   enable it to be operated in a manner similar to the display terminal 338. As previously

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discussed, the reading device 348 includes a processor and a memory which enables it to operate independently of the processor and memory of the display terminal. In this form of the invention the reading device is a bar code scanner, Model PDT 3100 made by Symbol Technologies. Of course in other embodiments, other reading devices may be used.

5   The reading device may be connected to the system by a data line as shown. Alternatively, the reading device may connect to the system by wireless communication methods, such as IR or RF. Inductive of capacitance coupling approaches may alternatively be used, as well as periodic electrical coupling techniques.

        In a first mode of operation, the reading device operates in accordance with the logic flow shown in Figures 47-49. As previously discussed, all authorized users of the system are

10   preferably provided with badges, identification cards, identifying articles or have distinguishing features which include machine readable indicia identifying them as authorized users of the system. The memory in the reading device 348 is configured to hold information concerning the indicia associated with authorized users. It is also preferably configured to

15   store and hold each user's personal identification number (PIN) uniquely associated with the user. The reading device also holds the particular quantity condition function data, such as dispensing or restocking, which certain users are associated with. All of this information is established in the data store 326 in the course of setting up the system and is down loaded into the configuration of the reading device 348 through an interface which resides in the display

20   terminal 338. The reading device 348 is configured so that it defaults to providing a "below

minimum" quantity condition message in the event that no other quantity condition is specified. The reading device 348 is also configured to produce transaction messages as well as other messages which are sent to other components of the system. These include messages which update the information stored in the data store 326.

5   The logic flow for the reading device begins as represented in Figure 47. A user wishing to operate the system through the reading device 348 begins with the processor executing a process 390 in response to a user scanning a machine readable indicia, which for purposes of this example will be a bar code. The bar code scanned may be indicative of a particular supply storage location. If such location indicia is scanned without first scanning indicia which identifies a user, the hierarchy in the configuration of the reading device previously described interprets the activity as indicating that the medical items stored in the position scanned are "below minimum". In response, the reading device 348 generates a transaction message which indicates that the medical items in the storage location have this quantity condition.

15   Alternatively, a user may find that a particular storage location is out of stock. In response to observing this quantity condition, the user may scan the bar code label similar to that shown in Figure 42. In response to scanning such a bar code process 390 causes a transaction message to be generated which indicates the out of stock quantity condition at the particular storage location. In accordance with the hierarchy in the configuration data, the "out" quantity

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condition is indicated when this label is scanned, regardless of whether the user is logged on

and whether the user is associated in the data store with a particular quantity condition.

Alternatively a user may indicate a below minimum or out of stock condition by scanning the

out of stock bar code at a storage location which will cause similar transaction messages to be

5   generated. Storage locations may be provided with "below minimum" labels similar to those

shown in Figure 44 so that a user may indicate the below minimum quantity condition by

scanning this label, without having to log on the system. Alternatively, if a user who normally

takes medications is logged on the system, a "below minimum" condition at a location can be

indicated by scanning a "below minimum" prefix label and then any label which includes the

10   location indicia for the location where the below minimum quantity condition exists.

Enabling a user to scan the bar code labels which are representative of the below minimum

and out of stock quantity conditions is a time saving feature. This is particularly true when the

user is indicating such conditions for non-itemized inventory. In such circumstances the user

is not required to log into the system, but nevertheless can indicate these conditions so that

15   persons with the responsibility for restocking the storage locations may be notified.

As indicated in process 390, if a user wishes to log onto the system using the reading device

they may first scan the bar code or other machine readable indicia on their badge,

identification card, etc., using the reading device. In response to the user scanning a proper

badge, identification card, or other item, the processor in the reading device proceeds to the

next process in the logic flow, process 392. Of course as indicated in process 390, if any bar code other than an appropriate bar code is scanned, an error signal is generated, an error indication is presented on the screen and the reading device returns to process 390 in the logic flow to wait for further input.

5   In process 392 a user is prompted through the screen 350 on the reading device to input their PIN. A user can do this through the keypad which is part of the input device 352. The configuration of the reader provides a predetermined time after scanning the badge or identification card for a user to input their PIN. If this input is not accomplished within the set time, the logic flow returns to process 390. Similarly a user may return to process 390 by

10   pressing a "cancel" key on the input device 352 or by sending a log out message. In the preferred form of the invention the log out message is generated by scanning a particular bar code which is conveniently placed for this purpose. In addition, or in the alternative, the reading device may be programmed to generate a log out message when it is returned to its cradle 354.

15   If a user proceeds to enter a PIN number within the time period provided, the reading device 348 checks the PIN against the data stored in its memory. If the PIN is verified as correct the configuration changes the operation of the reading device so that the subsequent scanning of position bar codes is taken to represent the particular quantity condition function which is associated with the user. As a result, if the stored configuration data indicates that the user

20   normally dispenses medications, the subsequent scanning of a position bar code will be

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interpreted as a dispense of that medical item (a "one taken" quantity condition). Likewise, if the stored data indicates that a user is normally involved with restocking activities, the subsequent scanning of a location bar code will be taken as a restocking event. Of course other types of quantity condition functions (or a no quantity condition function) may be

5   associated with particular users.

In the alternative form of the invention the report generating device, which is printer 384, generates reports. The report generating device preferably produces reports which include the names of patients who may receive medical items as well as indicia, such as bar code, which corresponds to each patient. In the preferred form of the invention, the reports further include

10   the medical items that have been prescribed for the patients as well as machine readable indicia representative thereof. This information is based on the information stored in the data store. Preferably the reports are limited to patients in the rooms which have been designated through the programming of the system as associated with the particular display terminal to which the reading device 348 is attached. In this embodiment a computer program called "The Bar

15   Tender" commercially available from Seagull Scientific Systems is used for generating bar code indicia. Of course, in other embodiments other programs may be used for producing the text and indicia which comprise reports.

In the alternative form of the invention, a patient may be selected using the reading device 348 by scanning the bar code associated with the particular patient printed on the report. The user

20   is preferably prompted to do this as the configuration logic executes process 394, as shown in

Figure 47. If the user scans a patient bar code, a timer built into the configuration of the reading device waits a time for the user to scan a position bar code. The user may accomplish this by scanning the position only bar code similar to the one shown in Figure 41, if the medical item to be taken is stored in an open storage location. If such a bar code is scanned a transaction message will be generated that such item was taken by the user for the indicated patient. The user may indicate that several of the same items were taken by scanning the bar code a number of times corresponding to what was taken. Similarly, the user may scan several different locations to indicate the different items taken for the patient.

If the medical items which are needed for the patient as indicated in the report 388 include items positioned in an electronic lock drawer 344, the user may scan the bar code on the electronic lock drawer. If the data stored in the data store 326 concerning the user indicates that they have authority to access the electronic lock drawer, such information will be included in the configuration data for the reading device. As a result, when the user scans the bar code associated with the electronic lock drawer, the access control system which controls opening the drawers, will open and make the medical items therein accessible. The user may then open the drawers where the medications are needed and may indicate the taking of medical items for the patient by scanning the position labels for the storage locations holding the medications, such as label 380 shown in Figure 45. This generates a transaction message indicating that the medical items stored in the storage locations for which the labels have been scanned have been taken for the designated patient.

In alternative forms of the invention, each of the drawers in an electronic lock drawer unit may be labeled with machine readable indicia which enables the access control device to provide access to each drawer individually. Likewise, the reading device 348 may be configured to provide access for users to the drawers selectively. This may be desirable when drawers of the electronic lock drawer unit 344 contain medical items which are only to be accessed by certain personnel, or which require two authorized users to log-in in order to access the medical items in a particular drawer. As will be appreciated from the previous discussion concerning the display terminal, the reading device 348 may be configured to require two authorized users to log in to achieve the dispense of a selected medical item such as narcotics, in a manner comparable to that done using the display terminal.

It should be appreciated that while the process of using the reading device in connection with electronic drawer devices has been described, similar processes may be used in connection with other devices which hold medical items. These include refrigerators such as refrigerator 527, cabinets and various other types of units which include storage locations for medical items.

After a user has scanned the bar code at the storage locations from which medical items have been taken for the indicated patient, the user may log off the system as indicated in process 394 which returns the processor to process 390. Alternatively, the user may scan the indicia corresponding to another patient and may scan the storage locations for the medical items taken for that patient in the manner previously described. The user may take medical items for

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a number of patients before logging off the system. The configuration within the scanner causes transaction messages to be generated which include information about the dispense events. Such transaction messages preferably include data representative of the patient, the medical item and its storage location, the user of the system taking the item, as well as the time and date information that the item was taken. Of course the transaction messages also include data representative of the quantity condition which the transaction message represents. In the case of a dispense quantity condition, the transaction message includes a quantity condition indication which includes data representative of a dispense. This indication distinguishes it from transaction messages which indicate other quantity conditions such as below minimum, out of stock or restocked. The processor and the configuration in memory in the reading device serve as a quantity condition indicating device which operates to generate the quantity condition indication which is included in the transaction messages.

As shown with reference to the logic flow associated with process 394, if an improper scanning operation is performed, the logic returns the system to an appropriate process. The configuration of the reading device is also set up to provide the user with appropriate textual prompts. For example, the configuration of the reading device causes the system to consider the next transaction to be a dispense due to data stored for a user who has logged on the system. However, rather than indicia associated with a patient being scanned next, a bar code associated with a storage location is scanned. In this case the logic in process 396 is executed by the processor in the reading device. Process 396 directs the logic flow to the appropriate process based on a sequence of inputs made. Further as shown with regard to process 394, a

user operating the reading device is free at any time to scan the bar codes to indicate a below minimum or an out of stock quantity condition at a storage location, which causes a transaction message to be generated corresponding to the condition which is read.

Alternative embodiments of the invention may operate dispensing devices, such as dispenser

5   346, or enable access to storage locations which are controlled by access control devices, such as lock drawer unit 344, or refrigerator 527, in response to indicia which corresponds to the medical items prescribed for patients printed on the reports. The reading device 348 is preferably configured to include data representative of the storage locations within the dispenser and other devices. A user wishing to dispense a medication from a dispenser, rather

10   than scanning a storage location or an electronic lock drawer unit, may scan the indicia corresponding to the medication desired from the report. In response, the reading device causes the medical item to be dispensed from its storage location in the dispenser, if that is where the item is found. Similarly, if the medical item corresponding to the scanned indicia is stored in the electronic lock drawer or the interior area of the refrigerator, the access control

15   device will enable the drawer or refrigerator holding the item to be accessed by the user.

The ability to dispense and access medications based on the machine readable indicia from the reports further increases the speed at which items may be dispensed and the information recorded for eventual storage in the appropriate data store of the system. Further, in this alternative form of dispensing medications, a confirmatory step may be required by the

20   configuration of the reading device so as to provide an indication that the requested item was

in fact dispensed or taken. This may include for example the user providing an input through

the keypad, which is part of the input device 352 of the reading device, or alternatively

scanning machine readable indicia on the dispenser, or on their identification card or badge.

Such functionality may be readily included with the logic which is part of process 394.

5   The various signals which have been scanned or otherwise input into the reading device 348

are used to generate the transaction messages. This may be done as data is being read or is

preferably done after the user logs off the reading device. The transaction messages are

standardized within the system and are generated in accordance with the configuration data

stored in the reading device. The transaction messages are preferably dispatched in a batch

10   mode after the user logs off to avoid slowing the user down waiting for messages to be

transmitted to other parts of the system. When the user logs off the transaction messages are

sent through the interface in the display terminal 338 and into the network 328 from which

they are received by computer 324 or other computers connected to the system. The

transaction messages are used to include information about the quantity conditions and other

15   events which have been carried out, in the data store 326. Of course it should be understood

that the transaction messages may be sent to a number of different computers and modify data

in numerous data stores depending on the programming of the particular system.

In this embodiment of the invention, after the transaction messages have been sent by the

reading device 348 to other parts of the system, the computer 324 is operative to down load

current configuration data into the reading device. This assures that the most current

information is configured in the reading device.

In the operation of the alternative version of the invention, the transaction messages received

by computer 324 may be indicative of a need to replenish the supplies of medical items at

5   certain storage locations. This is true regardless of whether the transaction messages are

generated based on inputs to the reading device or to the display terminal. In response to such

conditions being indicated, computer 324 in cooperation with computer 386 or other similar

computers positioned elsewhere in the system and connected through the network 328, is

operative to cause a report generating device such as printer 384 to print a report concerning

10   the storage locations needing to be restocked. Preferably the report includes information

concerning the storage locations requiring restocking, the medical items stored therein, and the

quantities of such medical items that are needed. The report preferably includes this

information both in human readable and in machine readable form.

A person who is to restock the storage locations for which the report is printed may use the

15   reading device 348 to facilitate the input to the system of restocking information. The

restocking function is further demonstrated with reference to the logic flow processes shown in

Figure 48. A restocking user who logs into the system does so in the manner previously

described with regard to a user who conducts dispensing activities. However, such a

restocking user will have data stored in the configuration of the reading device which indicates

20   that they perform a restocking function. From the process 394, with a restocking user logged

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on, the user preferably scans the bar code corresponding to a particular storage location to be restocked. An example of restock order bar code found in a restock report is indicated 398 in Figure 46.

Upon scanning the restock order bar code on the restock report, the logic executed by the

5   processor in the reading device next moves to process 400. In process 400 the user scans the bar code for the storage location being restocked. This may be the bar code corresponding to an open storage location, a location in an electronic lock drawer, a location in the interior area of a refrigerator or a location in the interior of a dispenser. The reading device 348 is preferably configured to prompt the restocking user to scan the position only bar code. After

10   the position bar code has been scanned the logic next moves to process 402 in which a user enters the quantity of medical items currently stored in the position. This is done by the user counting the items and using the numeric keys in the input device 352 of the reading device. The user is preferably prompted to do this on the screen 350 by the configuration of the reading device. The requirement to input existing quantities is only carried out for medical

15   items which are itemized and counted. For non-itemized items where absolute quantities are not a concern, the reading device is preferably configured to enable a user to avoid the input of current position quantities.

The current position quantity information is useful for counted and itemized inventory items as it can be compared to information stored in the data store 326 to verify that dispense events

20   have been properly recorded. If a discrepancy has occurred, the computer 324 is preferably

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programmed to provide an indication thereof at the administrator's workstation 336 or at another appropriate output device in the system.

After a user has input the current position quantity at process 402, the logic next moves to process 404 in which the user enters the quantity which is being restocked in the storage

5   location. The user is preferably prompted to do this by prompts presented on the display 350. Of course as indicated in processes 400, 402 and 404, if a user makes an error in the sequence of scanning or inputting, indicates that they wish to cancel the transaction, or the timers included in the configuration time out without receiving the next required input, the logic returns to an appropriate process.

10   It should also be noted in Figure 48 that a restocking user is also enabled to restock without using the restock order bar code on a restocking report. As indicated in the logic flow a user who has restock rights is enabled to move from process 394 to process 402 by scanning the position on the storage location to be restocked.

Of course restocking operations cause the reading device to generate signals which are

15   indicative of the quantity condition associated with a position being restocked. The reading device is operative based on its configuration to build transaction messages corresponding to the restocking activities at the various storage locations. These transaction messages include data representative of the user performing the restocking activity, the storage location, the medical item involved, as well as the time and date of the activity. Again these transaction

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messages are not transmitted to the other components of the system until after the user logs off the system. This assures that the restocking user may perform their operations at the fastest possible rate.

Figure 49 shows the logic flow associated with the generation of transaction messages which indicate that the number of medical items stored in a storage location is below minimum or out of stock. Generally such transaction messages will be generated by scanning a position bar code when the reading device is in the "default" mode due to no user being logged on. Alternatively, a prefix bar code indicia representative of a "below minimum" with location indicia, or an "out of stock" indicia at a location may be scanned at any time. This is represented by logic process 406 which is indicated as the calling state in Figure 49. It should be understood that the calling state may be either process 394 or process 390 as indicated by process 406. As shown in Figure 49 from the calling state 406, provision is made when a restock order bar code is scanned from a report, to move to logic process 408 in which a user scans the bar code for the position being restocked. This enables a restocking user to indicate that the position is being restocked. Also from the calling state, a user can scan a prefix bar code which may include quantity conditions such as below minimum, out of stock, or restocked, and then a bar code including a position or location. This causes the logic to move to process 410 which produces transaction records accordingly.

The logic flow process described in Figure 49 provides system flexibility. This logic enables the user to scan sequentially a prefix label, and then a position label so as to selectively

indicate a particular quantity condition for a storage location. This may be advantageous, such as for example, when a restocking user is scanning machine readable indicia from a report and from storage locations. Of course many arrangements of machine readable indicia both on reports and storage locations, as well as logic flow processes are possible depending on the

5   needs of the system operator.

The alternative system 322 shown in Figure 40 may be programmed to have the reading device 348 configured to operate in conjunction with the display terminal 338, rather than as a completely separate user interface device. In some alternative embodiments it may be desirable for users to select patients using the screen 340 of the display terminal in the manner

10   previously described when dispensing is conducted using the touch screen interface of the display terminal. Thereafter, the user may indicate taking of medical items from storage locations by scanning the machine readable indicia associated with those storage locations with the reading device. Likewise dispensers, electronic lock drawers, refrigerators or other storage locations, access to which is controlled by an access control device, may be operated

15   so as to render medical items therein accessible in response to scanning of indicia associated therewith by the reading device. The taking of such items for the patient selected at the display terminal may be recorded in the data store upon such medical items being rendered accessible by the access control device, or may require further input to confirm the taking of the item either by scanning or by an input to the display terminal. The sequences and

20   processes may be varied to suit the level of security desired for the particular medical items involved.

It should be understood that while the report generating means of the described alternative embodiment is a printer which enables the printing of bar codes, other embodiments may include other types of devices which may produce machine readable indicia. These may includes devices which include hard copy or other types of displays or signals, which are

5 capable of being read by a machine. Alternatively, in certain embodiments the reading device may be programmed to read human readable text provided on a report or other output device. In alternative embodiments audio, magnetic or other indicia may be substituted for the optical type machine readable indicia that have been previously described.

A further novel aspect of the alternative embodiment of the invention is associated with its

10 capability of operating to perform dispensing and restocking activities despite other components of the system becoming inoperable. Specifically the reading device 348 may continue to operate to record dispense and restock transactions despite a malfunction of the display terminal 338, network 328 or any of the other connected computers or systems. As previously discussed, the reading device 348 generates transaction messages in response to the

15 signals generated therein. The reading device is preferably configured so that if the batch transactions cannot be successfully transmitted to other parts of the system, such transactions will continue to be held in memory in the reading device. It may be desirable to continue to have the reading device hold a record of the transactions for a period of time, even though they have been successfully transmitted to other components of the system. This enables

20 recovery of the data should it later be lost from the data store 326 or other connected system components.

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The capability of the reading device 348 to store and later forward such transactions creates a possibility that quantity condition information may reach the data store 328 after later, more current information has been stored therein. It would be undesirable to modify more current information with previously generated data which may no longer be accurate.

5   To overcome this problem the transaction messages, as previously discussed, include a time of each transaction. The time preferably includes both time and date. The data store 326 likewise includes data representative of a time (and date) the data which is used to update the data store was generated. Upon receiving data from a reading device (or preferably any device such as a data terminal or other system component which has the capability of operating

10   independently) the computer connected to the data store is operative to compare the time information associated with the transaction data it is receiving with the transaction time of the most recent data that it has already received. If the time associated with the transaction message it is receiving is more recent than the update to the data it has most recently received, the data in the data store is updated accordingly as is the transaction time information

15   associated with the update.

On the other hand, if the message being received by the data store is associated with a transaction which occurred at a time which proceeds a more recent update to the same data, the computer 324 will not supersede the more recent data. Rather the computer is programmed to store the transaction message data and use it for further processing. In certain

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cases the message will be sent to the administrator's workstation so that a system operator may review whether the data which the system has maintained needs to be modified.

An example of a situation where the computer 324 may have received more recent data before older data is received is when persons restocking the system use other types of input devices to indicate restocking data. The reading device 348 may generate a transaction message which indicates that a particular storage location is out of stock. However, due to the periodic transmission of the data from the reader, or other operational factors, the data store may not have received the transaction data for a time after the user reads the indicia from the location. A restocker using a separate message connection path into the network, such as a portable terminal, may have restocked the position subsequent to the out of stock indication being read. The restocker's data may have been received at the data store. Without the provision that is made in this embodiment for checking the time information in the transaction messages, a subsequent receipt by the data store of the message that has been in storage in the reading device would wrongly cause the data store to indicate that the storage location was out of stock. Because the system includes the feature for selectively updating the data based on the time associated with the transaction message, the risk of such problems is minimized.

The ability of the system to selectively update the data store based on the time that message data originated enables the operation of alternative embodiments of the invention in which dispensers, lock drawers, refrigerator lock modules and other devices need not be in continuous communication with the other components of the systems.

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In such an alternative embodiment electronic lock drawers, refrigerator lock modules, dispensers and other medical item storage devices which selectively control access to medical items, similar to those previously described, are used. However in this alternative embodiment such devices include or are in operative connection with a local processor and a

5   memory. The local processor is connected to a local message input device and a local message output device of conventional types which enable the processor to send and receive messages. In one form of this embodiment the local input and output devices include IR receivers and emitters respectively, but other types of wireless or other connections may alternatively be used.

10   In this alternative embodiment the reading device used is similar to reading device 348 except that the reading device preferably includes a wireless interface that is capable of communicating with the display terminal or the network, as well as with the local message input device on the dispensing devices.

The local memory on the dispensing devices is preferably configured to hold data

15   representative of authorized users, as well as medications stored in the various storage locations in the dispenser. The local memory is also configured to cause the processor to operate to make medical items available in response to an appropriate message received at the local message input device. The local memory is further configured to generate transaction messages which include data similar to transaction messages generated by the reading device.

20   The configuration of the local memory in the dispensing device is preferably established by

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downloading data into the local memory through the local message input device. This may be

done using an IR communications interface in the network which communicates with the

dispensers, or by using a portable terminal device to provide the configuration data.

In operation of this alternative embodiment, a user logs on the reading device in a manner

5   similar to that described in the previous embodiment. The reading device operates in a stand

alone manner based on its configuration data.

A user operates the reading device by scanning patient and medication data from reports or

otherwise in the manner previously described. However, unlike the other embodiment where

the reading device transmits its signal to the data terminal and the data terminal transmits a

10   message on a data line to a dispenser, in this embodiment the reading device sends its output

directly to the local message input device by IR coupling. The message from the reading

device preferably includes data representative of the authorized user who is operating the

reading device. The processor in the dispensing device preferably checks the user identity

data against the configuration data related to authorized users in its memory. If the user is

15   indicated as authorized, the dispenser makes the medical item indicated by the message

available to the user. The reader also preferably provides as part of the message to the

dispenser, data representative of the patient (if appropriate) and other data that is included in

the transaction message eventually generated by the reading device. This information is also

stored in the memory of the dispensing device. Of course, the processor in the dispenser may

20   provide the time data and other data directly or from its local memory.

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The dispenser through its local output device preferably provides data to the reading device representative of the storage location from which the medical item was provided. The reading device holds this data and incorporates it into its transaction message data.

The reading device is eventually again placed in communication with the network 328. This may be done by returning it to its cradle in which it is coupled by IR or in another manner to the network. The transaction messages produced by the reading device are used to update the stored data concerning the patients and the medical items in storage locations as in the previous embodiments.

Periodically data from the memory of the dispenser is delivered to the remainder of the system and used to verify the transaction messages from the reading device. This can be done through the local message output device being coupled to a receiving device connected directly to the network 328, or by use of a portable terminal which receives and stores the data. The portable terminal is eventually connected to the network. The computer comparable to computer 324 in this embodiment is programmed to compare transactions from the dispensers to those already received and to disregard duplicates of transaction already received. Any discrepancies may be directed to the appropriate function in the hospital or other facility in which the system is operated.

The reading device may also be used during restocking of storage locations in the dispensers in the manner previously described. The reading device provides messages which are used to

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update the stored data. The data from the memory of the dispenser may be used to verify the reading device data and to identify discrepancies.

As will be appreciated, this alternative embodiment has the advantages that the dispensers and storage locations are totally "stand alone" units. This offers greater flexibility in their placement and reduces cost of installation of the system. The alternative form of the system further provides the advantage that if the reading device is lost or damaged, records of any activity conducted since the reading device last sent messages to the network can be recovered from the dispenser memories. The dispenser memories may be configured to hold data for such time after providing the data back to the network to assure data recovery.

It should further be understood that in this alternative embodiment more than one dispenser or similar device may share the same local processor, memory and input and output devices. Further, open storage locations may have a local processor, memory and connected input and output devices adjacent thereto to store a record of the transactions conducted with the reading device at the open storage location. Of course such processors and memories would not need to be configured to perform any dispensing control activities which would simplify installation and operation. Other arrangements and alternative systems will be apparent to those skilled in the art from the foregoing description.

The medication dispensing system of the present invention may be used in connection with a plurality of different types of devices which store and dispense medical items. For purposes of

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narcotics, which are tightly controlled, a medicine dispenser which holds the medical items in a secure enclosure prior to dispense and which dispenses such items in a manner that can be controlled and confirmed is preferred. Medicine dispenser 100 is such a dispenser that is used in connection with dispensing medications. A further example of a suitable dispenser is shown

5   in co-pending U.S. Application Serial No. 60/045,137 filed April 30, 1997, the disclosure of which is incorporated herein by reference.

The interior of medicine dispenser 100 is shown schematically in Figure 23. Dispenser 100 encloses a plurality of dispenser magazines 168 only one of which is shown. Each magazine

10   holds a plurality of ampules, vials or other medication holding containers 170 which are held in inclined relation in the magazine. Each of the containers in a particular magazine contains a predetermined dose of a substance such as a narcotic material that may be prescribed to a patient. Many forms of cylindrically packaged medications or medical items may be held in the magazines. Medicine dispenser 100 optimally houses a large number of magazines, each

15   one holding vials with a particular type of medicine. Each magazine 168 includes a dispensing mechanism later described in detail that releases containers in response to electrical signals one at a time from the lower end of the magazine. Released vials are guided on a chute 172 into a pocket 174 in a drawer 176. Drawer 176 may be a simple drawer or in alternative embodiments may be controllably locked and unlocked by an electronic lock 178 shown

20   schematically inside the medicine dispenser. Each magazine has a dispense verification sensor 179 associated therewith. Sensor 179 is operable to detect the actual dispense of a container from a magazine. Sensor 179 may be an optical, mechanical or other suitable sensor type.

When medicines are requested at the display terminal 102, the appropriate containers from the magazines 168 are released and fall down the chute into the pocket 174. After the vials have been released and are in position in the pocket, they may be taken. In alternative embodiments in which the drawer is controlled, the data terminal 102, in response to signals from the computer 84 unlocks the electronic lock 178 and enables the drawer 176 to be pulled outwardly so that the containers in the pocket may be taken.

Replenishment of the medicine dispenser 100 is accomplished by manually replenishing the magazines and indicating that fact through the data terminal in the manner previously described. To accomplish this the medicine dispenser has to be opened. This is possible only under the most secure of circumstances and through the use of a mechanical locking system comparable to that which is conventionally used to secure narcotics. Normally, two keys are required to open the unit and each key is in the possession of a different person.

The operation of the dispensing mechanism is shown in greater detail in Figures 10 through 22. Figure 10 shows the vials or other containers 170 in the magazine 168. As shown in Figures 11 through 13 because the magazine is tilted downward the containers tend to roll towards the front of the magazine toward an opening 180. The container adjacent the opening 180 contacts a guide 182 which is dog-legged in cross section. Guide 182 includes a tapered face 184 which is engaged by the first container 202 in the magazine. Guide 182 further includes an arm portion 186 that extends longitudinally adjacent the vials. Arm portion 186 has attached adjusting pins 188 which extend through the side walls 190 of the magazine.

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Adjusting pins 188 extend in angled slots 192 and may be fixed at selected positions therein
using nuts mounted on the pins or other suitable locking fasteners.

The movable mounting of the guide 182 enables the magazine to accommodate different
diameter containers by moving the guide in the slots 192 to provide sufficient clearance for a

5   container to pass onto the guide adjacent opening 180 but not so much clearance so that the
vial can fall out the opening without the actuation of the gate members as later explained.

As best shown in Figures 14 through 16, a front gate 194 and a back gate 196 are mounted
adjacent to opening 180. The front gate and back gate are mounted on a front gate shaft and a
back gate shaft 198 and 200 respectively.

10   As shown in Figure 14 in the inoperative position of the gate members front gate 194 engages
the underside of first vial 202 adjacent opening 180. The end of front gate 94 engages
container 202 at a position outward towards opening 180 from a location on the surface of the
container diametrically opposite where container 202 engages tapered face 184 of guide 182.
As a result, the container 202 is prevented from passing out through opening 180. In this

15   position any force applied to container 202 (if it could be accessed) would tend to be resisted
by compressive forces making it very difficult for the container to be manually removed. In
the inoperative position of the magazine shown in Figure 14 the back gate 196 has its upper
end extending parallel to a bottom wall 204 of the magazine. As a result, in this position the
back gate does not interfere with movement of the containers.

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In the actuation sequence for dispensing a container, the back gate rotates in a clockwise direction to the position shown in Figure 15. As it does this the back gate begins to move to a position blocking the container immediately behind container 202 in the magazine from moving toward the opening 180. In the position shown in Figure 15 the front gate 194

5   remains in its original blocking position holding container 202 in the magazine.

After the back gate has begun to rise as shown in Figure 15, the front gate begins to rotate in a clockwise direction toward the position shown in Figure 16. As the front gate 194 rotates container 202 is no longer held in the magazine and passes out the opening 180. The back gate having fully rotated as shown in Figure 16, holds the next container in the magazine from

10   moving until the front gate returns to its original position shown in Figure 14. When this occurs the back gate returns to its original position allowing the containers to roll forward and the next container is now in the position of container 202.

In the preferred embodiment of the invention, the slots 192 are oriented such that for any size container reasonably accommodated in the magazine, the front and back gates are positioned

15   so that the front gate 194 may assume an over-center blocking position in the closed position and the back gate can move to prevent the dispense of more than one container at a time. This ensures that with each cycle of the front and back gates only one container is dispensed.

The actuating mechanism for the front and back gates is shown in Figures 17 through 22. As shown in Figure 17 the actuating mechanism for the gates includes an electrical solenoid 206.

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Solenoid 206 has an actuating plunger member with a pin 208 extending traversely therefrom. Pin 208 extends traversely in a first slot 210 in a first actuator plate 212 which is attached to the front gate 194. Pin 208 also extends through an opening 214 in a second actuator plate 216 which is attached to back gate 196. As best shown in Figure 18 first actuator plate 212

5   has a traversely extending finger 218. In the position of the front gate shown in Figures 17 and 18, finger 218 engages a detent 220 in the second actuator plate 216. The purpose of detent 220 is to prevent finger 218 and front gate 212 from moving in a clockwise direction whenever the second actuator plate 216 is in its inoperative position as shown in Figures 17 and 18. This prevents a person who may gain access to the front of the magazine from being

10   able to deflect the front gate so as to cause the containers to be removed from the magazine.

As shown in Figures 19 and 20 the actuation of solenoid 206 by an electrical signal from the data terminal causes pin 208 to move second actuator plate 216 in a clockwise direction. This causes back gate 196 to move upward and detent 220 to disengage from finger 218. As a result, front gate 194 may move only after back gate 196 has risen so as to block the dispense

15   of further containers. Upon further movement of pin 208 by solenoid 206 the front and back gate move to the positions shown in Figures 21 and 22. In these positions the front gate is rotated so as to release container 202 while the back gate is extended fully upward so as to prevent the discharge of the next container in the magazine. Thereafter, discontinuance of the electrical signal to solenoid 206 returns the gate members to their original positions and allows

20   the next container to assume the position adjacent to the opening from the magazine.

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The dispensing mechanism of the present invention enables the controlled dispense of one container at a time from the magazine in response to an electrical signal. This assures that only the requested medication is dispensed. The same magazine may be readily adapted to containers or items of varying diameter by adjusting the position of guide 182. The magazine

5   also accommodates containers of different lengths. In addition, the gate members are suitably secure so as to avoid tampering by persons who might attempt to gain access to the interior of the medicine dispenser 100 through the dispenser drawer 176.

The dispensing mechanism also assures that the requested medical item has been dispensed. This is assured by using signals generated by sensor 179 to minimize the risk that a dispense

10   will be recorded which has not actually occurred due to a malfunction. Circuitry in the dispenser is connected to the sensor 179 and transmits signals when a container passes out of a magazine. These signals are checked to see if they are generated when a signal to dispense to the corresponding magazine is given. The dispense of any item from a location and the provision of such item to a patient is only recorded in the computer data store when the

15   dispense is verified by the sensor associated with the magazine. Alternatively, in other embodiments a bar code reader may be installed in the dispenser and bar code applied to the containers to verify not only the dispense but the type of item dispensed.

Although in the above described embodiment of the medicine dispenser the gate members are shown as extending the entire width of the magazine, in other embodiments the gate members

20   may have other configurations and may be of different designs so as to extend only a portion

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of the width. Although in the preferred form of the invention the magazines extend in downward tilted relation in other embodiments they may be arranged to extend vertically. In such alternative embodiments guides may be provided to hold the containers adjacent to plate 204. Further, the containers may be dispensed in a vertically upward direction through

5   incorporation of spring loading to bias the containers upward in the magazine. A fundamental aspect of the invention is that the gate member which corresponds to the front gate member engages the container in an over-center position with regard to where the container contacts the tapered face, and the back gate member moves in synchronized relation with the front gate member to prevent the dispense of more than one container at a time.

10   The system for monitoring and dispensing medical items which includes the hook registers, box registers, electronic lock drawer, refrigerator lock modules and medicine dispenser previously described may also include or be used with other types of devices. These may include automatic dispensing devices as well as manual devices for which the inventory and use information can be input as a matter of practice at a conveniently located data terminal.

15   The system of the present invention is highly adaptable to accommodate medical facilities of varying size.   As the system of the present invention is also connected to a variety of computers which include data stores, a wide variety of parameters may be monitored and evaluated so as to avoid conditions of waste, fraud and abuse.

Thus the new system for dispensing and monitoring medical items of the present invention achieves the above stated objectives, eliminates difficulties encountered in the use of prior systems, solves problems and attains the desirable results described herein.

In the foregoing description certain terms have been used for brevity, clarity and

5   understanding. However, no unnecessary limitations are to be implied therefrom because such terms are for descriptive purposes and are intended to be broadly construed. Moreover, the descriptions and illustrations given are by way of examples and the invention is not limited to the exact details shown or described. In addition, any feature of the invention that is described in the following claims as a means for performing a function shall be construed as

10   encompassing any means capable of performing the recited function and shall not be limited to the means disclosed in the foregoing description or any mere equivalent thereof.

Having described the features, discoveries and principles of the invention, the manner in which it is constructed and utilized, and the advantages and useful results obtained, the new and useful structures, devices, elements, arrangements, parts, combinations, systems,

15   equipment, operations, methods and relationships are set forth in the appended claims.